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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C. E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

INTRODUCTION.

These papers are the outcome of an endeavor on the writer's part to epitomize a vast subject into such a compass that the student or layman whose experience is pre-supposed to be "nil" may grasp it in an intelligent way. It is intended to be a foundation course only, and as such, has been largely selected from the various works bearing on each department of the subject; but the proper balancing of the parts, if such there be, giving each its due importance, the combination of the whole subject, technically considered, as a ground work for future study, and the exclusion of much confusing detail which obscures the mental vision, the writer may claim as his own.

During the present period of depression, which always so seriously affects railway construction, it might be thought that the vocation of the railway engineer was being largely obliterated; but this is not at all a consequence. Our railways must be maintained, and while more engineers, per mile, are employed during construction than afterwards on maintenance, yet, although there are, no doubt, pleasant and remunerative positions to be had during the former period, there is no condition of permanence that makes them desirable. On the other hand, railway companies recognize more, every day, the value of a technical engineering training for those young men who fill junior positions in the operating and maintenance departments, not strictly engineering in their nature.

And those companies (*e.g.*, Pennsylvania, or Norfolk and Western) that have persistently filled such positions with young engineering graduates, that have had them do routine work and given them a business training, have seen their highest offices filled by men whose engineering knowledge has brought them to the front, when aided by a good business training, a knowledge of ways and means, and of traffic and operation.

In the future, such positions, and those on the maintenance staff proper, would seem to be the paths more likely to lead to success than the more strictly technical work of location and construction, particularly as the construction in future will be chiefly in the shape of short extensions of large systems having permanent staffs.

These papers, however, will deal chiefly with location, construction and maintenance, not because these cover the whole ground, but because a knowledge of traffic, rates, operation and management can be gained only by experience, whereas a good grasp of the former may be had previous to employment of such an extent, at least, as will be valuable in obtaining and filling junior railway positions, and also form a basis for future study. And even though very little of what is here given may be used at once by the young engineer, yet it will enable him to take a more intelligent interest in all that his superior officer does, which he could not otherwise do unless he had a proper understanding of the general principles on which railways are surveyed, constructed and operated. He is warned against having his faith in these principles shaken by the adverse criticism of men who do not appreciate or understand them. Care is taken to give here only what is fairly well tried and established.

On the other hand, he is advised to keep his opinions, largely, to himself, and to carry out faithfully the instructions of his superiors in office. These instructions, though perhaps sometimes faulty, should be studied and respected, so that when the time arrives that he, in turn, gives orders which must be obeyed, he may put into practice what he then considers, after several years' experience, to be best, not only theoretically, but from the standpoint of being feasible and advantageous, capable of being put into execution by his assistants—the best, all things considered.

It must not be forgotten that these papers are not exhaustive, but merely introductory. Years of reading, conversation, experience, observation, and above all, honest hard thinking, are necessary to complete a man's knowledge on any subject, and even then it is not complete. So that we must never desist, but always persevere, if we wish to keep up with the progress of this most progressive subject. C. B. S.

Montreal, Que., Canada, May, 1897.

CHAPTER I.—FUNDAMENTAL CONSIDERATIONS.

ARTICLE 1.—TRANSPORTATION.

The inhabitants of the civilized world have, since the year 1825, been enabled to remodel their ideas of

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

how and where to live. There has been developed within this period a new potentiality, which had through all the previous history of the world been practically dormant. The impulse given by it to the material and industrial progress of the world is such as to stamp it as one of the grandest events of our world's history, and it will be so spoken of in future ages. It is the development of transportation.

In its broadest sense, transportation may be said to include all means of communication; but of its various phases the transportation of material objects by means of the railway train will be the one treated of in this book.

The railway had its birth in England, and a fierce struggle took place between it and the canal for supremacy, while in North America the canal systems not being far advanced, and the extent of territory to be traversed rugged and vast, the result was never in doubt; to-day, the canal is a useful regulator of rates, and a means of transportation of heavy bulk freights in which time is not a factor, but it cannot be said to be a competitor of the railway to any serious extent.

By 1850 the people of North America had grasped the fact that the rapid extension of our railways to the remote and unsettled regions westward, was the key to that marvellous growth that has peopled a continent in so short a time. The capital available was small, and the country fairly rough, so that different methods of construction and operation from those in vogue in England, and a consequent different class of equipment, were imperative.

At the present day, in Canada, our railways are developed along the same general lines as those of the United States, and in it we have done our fair share, but it must be recognized that to the civil engineers of the United States is due the credit of those essential departures from early forms which have defined our continental types so distinctly, and are the glory and the boast of North Americans. These departures took place gradually, the gap becoming wider every year, until now it has passed its maximum, and the slow conservatism of English engineers is yielding. Bogie trucks, equalizing levers, Westinghouse brakes, and American cars are becoming familiar in England, while on the other hand increased wealth and traffic are enabling American railways to introduce block-signalling and interlocking systems, to abolish many grade crossings, and make their road-beds more solid and permanent.

The distinctive features of the railway system of North America that have enabled it to extend to a length of over 200,000 miles (including Mexico and Central America), that have given Canada a system of over 16,000 miles, moving 22,000,000 tons of freight, 14,000,000 passengers, 60,000,000 newspapers, 100,000,000 letters, besides much express, etc., each year, having a capitalization of $900,000,000, and employing an army of perhaps 55,000 men, are as follows:

(1) A frank recognition of the fact that curvature is not a great drawback, and can be introduced freely to economize construction.

(2) The introduction of bogie and swivelling trucks and equalizing levers, enabling lines of poor surface and sharp curvature to be operated safely and economically.

(3) The use of long wheel-bases on engines for freight work, enabling greater weight to be put on the drivers of engines operating over quite inferior track.

(4) The consequent hauling of increasingly heavier loads of freight per engine and per train crew.

(5) The lowering of freight rates to a point that enabled coarse freights to be worth moving, thereby increasing the volume of freight enormously.

(6) The acceptance of a timber-construction period, enabling roads with meagre early traffic to pay their small fixed charges and survive until their finances and credit are such as to enable them from their earnings or by increased bonding to replace such structures with permanent ones. The Canadian Pacific Railway is a striking example of this.

(7) The use of increasingly heavier freight cars, in which paying freight is a larger percentage of the gross load—and also giving a less co-efficient of rolling friction—which the following table illustrates:

1875	..20,000	lbs.	car,	20,000	lbs.	freight,	50 per cent.	dead load
1880....	24,000	"		40,000	"		37 "	"
1890....	28,000	"		60,000	"		31 "	"
1896 ..	36,000	"		80,000	"		31 "	"

From which it appears that the limit has been reached.

ARTICLE 2—PROJECTS.

A company of limited liability, but whose capital is inelastic and non-circulating, must do business or break down; it cannot contract its business in hard times except at a sacrifice; business at starvation wages is better than none, and this is the exact condition of a railway company which is a manufacturer and seller of transportation. In this it is different from a store, or more particularly a banking house, therefore all the more carefully should the project be studied before money is embarked in it.

No considerations of a general character will cover all cases, and therefore it will be necessary to exclude roads which have been or may be built (*a*) for purposes of blackmail, to force rival companies to buy them out; (*b*) for speculation of the builders, not owners. These are not legitimate enterprises, but ones which projectors start by the expenditure of a small sum for charter, issue of bonds, etc., expecting to charge a margin for selling the bonds, to form construction companies, and let the contracts of construction to themselves at high prices, getting all the money out of the bondholders, running no risk themselves, but controlling all management by means of valueless stock. This gives them all the voting power, and any extra profit remaining after the bond coupons have been paid. Even such roads as these, however, will profit in the same way, as legitimate enterprises, by the application of true economy in location and construction.

Cost is the basis of all business, and most particularly in the case of railways must this always be so. An engineer may insist on technical accuracy and massive work, to such an extent as to bankrupt his company before the road is on a paying basis or even built, or he may, in an ill-directed effort toward economy, give it such a miserable constitution of grades and position, relatively, to its customers, that it will never secure traffic, and could not handle it economically if it did. Between these two extremes, the intelligent engineer should strike a happy balance, so that the project may be where it can obtain most traffic, at least first cost consistent with moderate working expenses, so that it will be profitable to the present owners or promoters, who usually build the road on borrowed money up to a certain safe mortgagable amount.

The promoters of roads are always sanguine, and probably the most common error into which such men

usually fall, is to overrate the funds on hand or in view, and on the other hand, to underrate the cost of the completed enterprise. Roads are seldom built within their first estimated cost, and therefore, this is a danger against which the chief engineer must guard; he must be sure and firm in his figures, because it is difficult to foresee all contingencies, and still more so to impress the directors with the reality or necessity of each item.

The finances at the command of the company should always be fully known to the chief engineer; he has the right to know it, and should have the courage to insist on the fullest confidence of the directors. These means should be carefully studied, allowances made for changes in the money market affecting the value of bonds, the amount of money which can be raised easily, and the difficulty in getting the *last* part of the required amount should also be considered. Usually the bonds of new roads, just being built, sell below par, and, as the amount issued increases, the selling price may get less and less, until they may become unsaleable.

Many roads become bankrupt before or just after construction is finished, and a promising project ends in a receivership, the wiping out of past debts, or issue of prior-lien bonds on the part of the bondholders themselves. Receiverships, instituted originally to protect bondholders, are often made the instruments of defrauding them. The history of the railways of the United States, particularly, is full of examples of unnecessary roads built on faith and hope, and ending in disaster or fraud. Over 25 per cent. of United States railways are now in receivers' hands, and nearly all have passed through that stage in some period of their history.

The most casual observation teaches that in a country like Canada, where traffic is still unfortunately very light, we must build roads with the utmost economy. This has been practised in several justifiable directions.

(*a*) The introduction of curves where necessary, with a sharpness of as high as 4° to 6° on main lines, and 8° to 10° on branches, with a frequency only limited by a piece of tangent of 200 to 400 feet long between curves; in this way, by a slight addition to the cost of hauling trains and length of line, the cost of road-beds has been kept at a minimum.

(*b*) The use of fluctuating grades, by which the local "sags" or depressions do not increase the cost of hauling trains, but cheapen the cost of construction materially, and which have no objectionable feature except a change in train speeds, as they store up or yield a part of their "velocity head."

(*c*) Timber structures over all important streams, and even timber box culverts under light banks; in this way a railway company is enabled to get its road in operation quickly at a minimum cost, is able often to tide over the first few years of meagre traffic, replacing them, gradually, as means will permit, with permanent structures. On the other hand, there are certain directions in which economy cannot be practiced.

(*a*) Narrow gauge roads, except in isolated cases, have now been abandoned, because the demands for interchange of traffic put them at a disadvantage; because the cost of construction is higher in proportion to carrying capacity of cars, etc., and chiefly because it is found that American engines of standard gauge can pass around any ordinary curve quite freely.

(*b*) Light rails. This will be dealt with more fully in future chapters, but it may be well to say here that with rails quoted at $20 to $25 per ton, there is no greater blunder than to buy light rails. In stiffness, strength and wear the increase varies nearly as the square of the weight per yard, thereby decreasing maintenance charges enormously as the weight increases. The present weights are roughly 60 lbs. per yard for branches and 80 lbs. for our main lines, with a strong tendency upwards.

(*c*) Excessive ruling gradients. Almost any other mistake can be corrected in time, curves can be flattened, short grades lifted, temporary structures replaced, but the ruling grade is the life or death of a road that has or expects to have any traffic beyond a meagre minimum. This question will be fully dealt with in Chapter II.

(*d*) Locating roads adjacent to but not through towns. Many instances might be given of this fact, where railway companies, in order to save money on right of way, to shorten the line slightly, or out of pique at not receiving bonuses, have built the road a mile or more away from the centre of population. Experience proves, however, that it is usually profitable to pass as near as possible through the *very heart* of all towns or cities, even at considerable extra expense.

The engineer must, therefore, when entrusted with a study of proposed routes, have several leading ideas constantly in his mind:

(1) How to obtain the most traffic, including the idea of shutting out, avoiding or fighting competitors.

(2) How to get a road built with as small fixed charges as possible consistent with small operating expenses, and clause (1).

(3) How to build a road that will be operated and maintained at as small a charge as is consistent with clauses (1) and (2). *These three things are intimately intertwined*, but may be affected by such considerations as obtaining heavy local aid, having heavier grades in direction of lesser traffic, and a complete change of train loads at the end of each engine division (100 to 130 miles), excepting always that the whole road will allow the passage of moderately heavy passenger trains intact.

Unfortunately these matters are often, erroneously enough, may be, settled quite apart from engineering ideas, politics and local aid being the controlling factors; but facts remain, and while politicians perish and local aid, once given, looks for a *quid pro quo*, the railway burdened with too heavy grades, too much debt, or distant from its customers, will gradually, but surely, fail in the race. The problem which has to be solved, in each case, is to create a paying property without satisfying, often, the dangerous desire on the part of the engineer to build solidly and erect monuments to himself, or satisfy his innate desire for excellence of construction considered from too narrow a standpoint. This is a difficult matter in a thinly settled country like Canada, as statistics to be given will show, but our roads are being more economically constructed and operated day by day and traffic is slowly increasing, so that we may confidently look forward to a time when there will be a change and some small returns for the stockholders and promoters.

(*To be continued.*)

MOVING TIME!! Our subscribers are reminded to notify us of any change in address necessary. Give both old and new addresses. THE PUBLISHERS.

BRITISH RAILWAY ENTERPRISE.

(*Correspondence of* THE CANADIAN ENGINEER.)

Before the writer set foot in England he was inflated with the idea common to Americans (using this word in a continental sense) that we were ahead of the world in railway enterprise and railway management. A few journeys over Great Britain and a short study of the two systems will dispel that idea as an illusion.

ENTRANCE TO EUSTON STATION, LONDON AND N.-W. RAILWAY.

It is true that the American tourist will, generally speaking, miss his convenient system of baggage checking, and will see the faults of the compartment system of passenger cars ; but if he travels by the London and North-Western Railway, he may have the American system applied to his baggage, with the American feature of "baggage smashing" omitted, and if he is travelling on a through train he will find dining cars, sleeping cars and parlor cars on a modified American plan, quite as luxurious, quite as convenient and affording easier riding than any in the United States. But assuming that this splendid Americanized special service on the London and North-Western did not exist, the unprejudiced American will find on investigation that the system in use in the United States and Canada could not be wholly applied to Great Britain without depriving it of some of those distinctive points which make it on the whole the most efficient and best managed railway system in the world—for in the three great essentials, solidity of construction, average speed of trains, and safety of passengers, the railways of Great Britain stand unequalled. On a previous visit to England the writer remembers reading the annual report of the London and North-Western. Out of over 25,000,000 passengers carried that year by this company, not a single passenger's life was lost! Think of the efficiency, the care, the regularity and intelligence this means. No such record has been known in any corporation of like dimensions in the history of American railways. Then as to speed, it is true that the "Empire State" express on the New York Central now holds the record for the fastest train in the world, but that is an exceptional performance, and the average speed of the New York Central expresses is below that of the leading English railways. Taking a late time table of the London and North-Western, I find that the six expresses running daily from London to Carlisle make an average of 45.4 miles per hour, and on the return to London the eight expresses make an average of 44.5 miles per hour, while the New York Central's four expresses from New York to Buffalo make an average of 43.6 miles per hour, and returning from Buffalo to New York the average is 42.9. The difference is nearly two miles per hour in favor of the London and North-Western, though the grades on the English road between Crewe and Carlisle are much more severe than those on the New York Central.

Although the area of Great Britain is so small compared with the United States and Canada, and although it has been for years covered with a net work of rails, while vast regions of America are still unserved, the mileage of new roads was relatively greater during the last year under review (1895) in Great Britain than the United States, and what is still more remarkable, the British roads return better dividends. In 1895 there was added to the United States railways 1,628 miles, while in Great Britain the mileage added was 270. In the same year the railways of the United States earned a dividend of 2.94 per cent., while those of Great Britain earned 3.95 per cent. In both cases the dividends are less than in former years ; partly due, no doubt, to the increasing use of the bicycle, and in the case of the United States to the growing competition of the electric railways in some States. In addition to this the widespread depression in the United States has no doubt put a check on new enterprises, and new roads are not built for the benefit of contractors so much as they used to be. Anyone travelling over Great Britain is struck with the solidity of the permanent way, the substantial character of the stations,

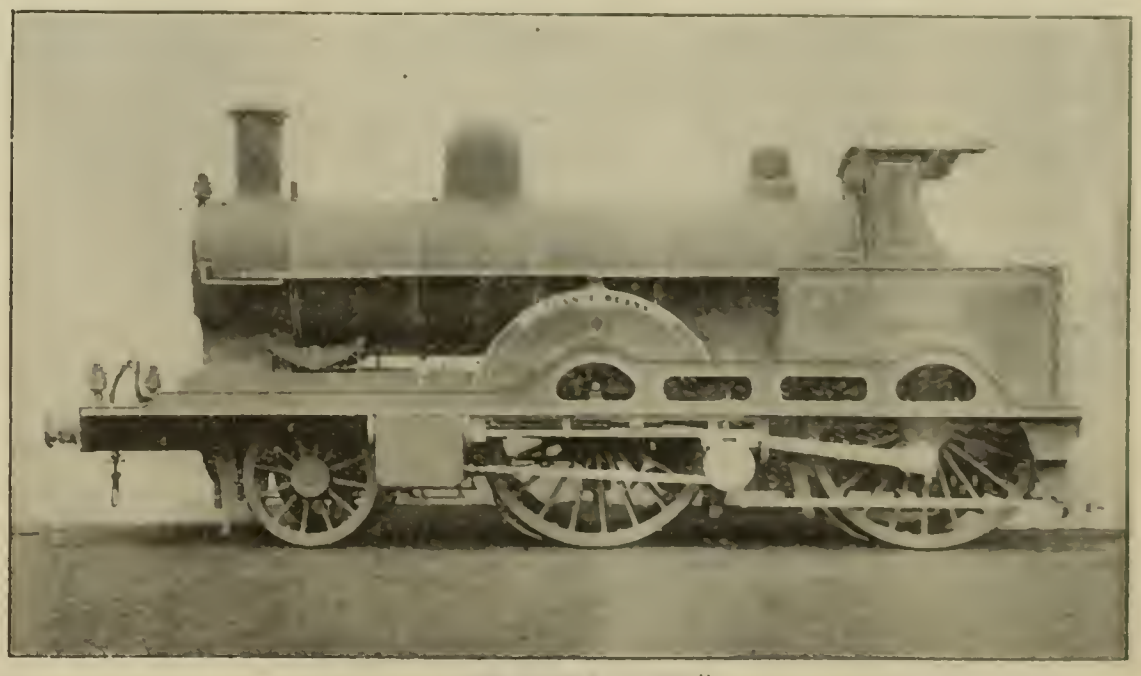
"LADY OF THE LAKE" PASSENGER ENGINE, WITH 7 FT. 6 IN. DRIVE WHEELS—L. & N.-W. RY.

the numbers of solid bridges, viaducts, culverts, archways and tunnels—all built to last for ages. The English railway builder goes through a mountain, the American goes over it. The cost of construction of British railways is about double those of America, but the receipts of British railways in 1895 were over three times those of the United States, being $19,220,

against $6,170 per mile. British railways are operated more economically than American, for of the gross receipts of the United States railways 70.30 per cent. were absorbed in expenses, while in Great Britain the expenses are 56 per cent. of the receipts. About a quarter of the revenue of the United States railways is derived from passenger traffic, while the passenger traffic of Great Britain is 46 per cent. of the whole. The total freight handled in the United States, in 1895, was 763,750,000 tons, while Great Britain, with one-ninth of the mileage, handled 334,000,000 tons. In the last ten years $72,500,000 were spent on new railways and improvements in Britain, there being 1,842 miles built in that time; and the total capital now invested in the railways of these islands is £5,005,000,000. The average annual increase in the passenger traffic is 23,000,000 passengers, though the increase in 1895 was only 19,750,000. The enormous amount of passenger traffic handled in England, and the admirable order with which the vast crowds are carried on special occasions, such as holidays, is one of the marvels of British railway traffic. In Yorkshire and Lancashire, the factory population hold what are called "wakes," the annual summer holidays, when thousands upon thousands swarm to the seaside or mountains, having saved up by means of "going away clubs," sufficient for the festive occasion. Last summer, in the town of Oldham alone, a total of $750,000 was drawn from the funds of the "going away" clubs, and half of this big total was spent at Blackpool, the popular seaside resort of Lancashire. This attractively situated seaside town is reached by the London and N.-W., and on the occasion of the last Oldham "wakes," no less than twenty special trains were required to convey the holiday-seekers of that town to Blackpool. On the last bank holiday, twenty-seven special trains had to be provided to take holiday seekers from Liverpool to Southport—another seaside resort of Lancashire fed by the L. & N.-W. Though this was nearly double the number that had been calculated on, the extra traffic was provided for without hitch or accident. Altogether, on that single day, the L. & N.-W. ran 150 special trains into Blackpool alone, yet not a mishap was reported, and the regular service went on with nearly its usual regularity. Within a comparatively short time, on that day, the booking clerks (ticket agents) of the L. & N.-W., at Liverpool, made change for 9,219 passengers and took in £2,449; while at Birmingham, the same day, they sold 21,978 tickets, and took in £6,658. On the day before this, at Euston Station, London, the sum of £5,414—$27,070—was received for passengers' tickets. To supply all these tickets, give the correct change instantly, as they must do, to keep account of the cash, and answer enquiries, implies a combination of alertness and coolness which seems almost supernatural to the lay mind. Yet the same trained intelligence is required in the engineer, the signalman, and the other employees who have to cope with work requiring such lightning-like activity, and who have so many thousand lives dependent on them.

INTERIOR OF SALOON CAR, LONDON AND NORTH-WESTERN RAILWAY.

Two samples of London and North-Western express engines are given in this letter, these being of the class that will carry the tourist from Liverpool to London—a distance of 100¾ miles, in less than four hours and a-half; and they can easily run over a mile a minute. The L. & N. W. have over 3,000 engines, all built at their workshops at Crewe (which will be referred to in another letter), and the value of these engines is over $25,000,000. One of them, the old *Cornwall*, having a drive-wheel 8 feet 6 inches in diameter, has just been laid off after 50 years of service. Every five days a new engine is turned out from these shops, and 2,000 come in each year for overhauling, there being an average of 330 in hand at a time. The "Jeanie Deans" compound express engine, which hauls the Scotch express from Euston, frequently takes 18 to 20 cars, including the heavy dining-cars. The "Greater Britain," another recent engine built at Crewe, is perhaps the most powerful locomotive in existence. Though heavier than any other on the line, it does not put any more steam on the permanent ways or bridges, owing to having an extra pair of small wheels underneath the foot plate, these wheels having half an inch of side play. The front wheels have a patent radial axle-box—designed by F. W. Webb, the company's



"THE JEANIE DEANS."

mechanical engineer—so that the engine, though of great length, can travel safely over curves. The engines on the L. & N.-W. consume over 3,000 tons of coal per day. In my next letter I shall speak further of this company's great shops at Crewe

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For THE CANADIAN ENGINEER.

FORMATION AND AGGLOMERATION OF FRAZIL AND ANCHOR ICE.

BY HOWARD T. BARNES, M.A. SC., DEMONSTRATOR IN PHYSICS, M'GILL UNIVERSITY, MONTREAL.

In northern countries there is no subject which presents so many practical difficulties to the hydraulic engineer as the formation of frazil and anchor ice, and their subsequent agglomeration into masses. The relations of these phenomena to the temperature of the river water have been repeatedly under investigation, but while much valuable work has been done already, the observations have been of such a contradictory nature, especially as regards the temperature of the water, that very few practical suggestions have resulted. The purpose of the present paper is to endeavor to present to the readers of THE CANADIAN ENGINEER a simple and intelligible explanation of the appearance of frazil, based on a long series of experiments undertaken on the St. Lawrence River, to show the dependence of its formation on the temperature of the water.

Among those, in later years, who have taken the keenest interest in investigating the question of frazil is John Kennedy, who is the chief engineer of the Harbor Commissioners' Works, at Montreal, and it was through him that the writer's attention was first directed to the importance of the work. Mr. Kennedy had long felt that some connection existed between the agglomeration of frazil ice and the temperature of the river water, but could not with the apparatus at his command satisfactorily demonstrate that such a relationship existed. Under his direction, as a member of the Montreal Flood Commission, temperatures of the river water during the winter were taken by W. J. Sproule, the assistant engineer, both under the surface ice and at Lachine in open water. Although great care was taken with the measurements, no definite variation from 32° F. could be detected even in the most severe weather. The measurements were taken with an instrument designed by Mr. Sproule, and consisted of a mercurial thermometer reading to tenths of a degree, enclosed in a tin case so that a quantity of the water to be measured was brought up and served as a protection against the colder air. By this means it was clearly shown that if any deviations from the freezing point took place, they must be less than can be measured on a thermometer reading only to tenths of a degree.

Mr. Kennedy, with the object of testing the matter more accurately by means of more delicate thermometers, consulted Prof. Callendar, of McGill University, in regard to carrying on the work by means of an electrical resistance thermometer. Prof. Callendar accordingly designed, and had constructed in the McDonald Physics Building, a thermometer capable of reading differences in temperature to the thousandth part of a degree centigrade. As the employment of this thermometer entailed considerable practice in the use of electrical measuring instruments, and Prof. Callendar was wholly occupied with the work of the session and had no spare time to devote to the observations, the writer undertook the measurements at Prof. Callendar's request.

An electrical resistance thermometer is really the only form of instrument suitable for measurements of this kind, not only because it measures with a far greater degree of refinement than can be looked for in a mercurial thermometer, but because it may be read from a sheltered place without withdrawing the stem from the water. Very little reliance can be placed on observations made on any temperature measuring instrument which has to be taken out of the water and read in an atmosphere cooled down far below freezing.

The thermometer used was of the differential type and consisted of two stems, each made of a similar coil of platinum wire. The coils were balanced against each other by the well-known Wheatstone's bridge method. The coils of wire were protected by small lead composition tubing, about eight inches long, which was soldered to longer and thicker compo-tubing containing the connecting leads. One end was made 100 feet long, to pass into the river, while the other end was made 10 feet long, for retention at a uniform temperature in a sheltered place.*

The temperature of the water was determined, not directly, but more accurately, as a small difference from a carefully prepared mixture of snow and water. Every possible error, due to changing temperature conditions, in the connecting leads and on the rest of the apparatus, was compensated for. The thermometer was so made as to have a scale of 8 inches to the degree and a vernier with lens reading to $\frac{1}{2500}$ of an inch. Under suitable laboratory conditions it was possible to measure to $\frac{1}{10000}$ part of a degree centigrade. In the present case, in spite of obvious difficulties in making refined electrical measurements in a light shanty unprotected from the wind, readings were accurate to $\frac{1}{1000}$ of a degree.

The method of making an observation consisted in immersing the two ends of the thermometer in a mixture of snow and water in the shanty, and obtaining a zero reading when both the ends were at 0° C. The shorter end was left in the mixture and the longer end passed out of the shanty into the river. Any difference in the temperature of the river from the mixture of snow and water in the shanty was immediately obtained. During the winter of 1895-96 the writer carried on the experiments for a considerable time on the river water, under the surface ice, opposite Montreal, and, during the winter of 1896-97, made a similar series of observations in open water at the Lachine Rapids. A shanty was provided at both places by the Harbor Commissioners, through the kindness of Mr. Kennedy, and served for the reception of the instruments and for making the measurements. A watchman was also procured to protect the instruments.

The results of the first series of experiments have been recently published in the "Transactions of the Royal Society of Canada," vol. ii., sec. iii., page 37, and those of the second series will, it is hoped, be published in the course of the year. In the first paper will be found, besides the results of the observations, a description of the instruments used in the investigation, and a brief discussion of some of the principal points brought out by previous observers.

The general results of the writer's experiments have

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* The writer desires here to express his thanks to H. T. Pye, instrument maker in the McDonald Physics Building, for willing aid in renewing, at short notice, delicate portions of the apparatus which were broken through want of proper laboratory conditions.

been to show that the temperature of the river water under the surface ice does not vary throughout its depth by more than a few thousandths of a degree from the freezing point during the entire winter. During the time in which the measurements were made the air temperature varied from −28° F. to + 40° F. Small differences from the freezing point are recorded, and these are found to accompany atmospheric changes. A sudden drop in temperature of the air below 0° F., after a warm spell of weather, would invariably send the temperature of the water slightly below freezing. On February 25th, 1896, an observation after a sudden cold dip gave a difference from the freezing point of −.005° C. On March 4th a similar cold dip gave −.006 to −.0004°, and on March 11th, −.004° C. It was found that these small differences below freezing never continued, although the air temperature remained cold. The river soon came to the freezing point with the apparent accumulation of frazil under the surface ice. During mild weather the temperature of the river never rose more than one or two thousandths of a degree above freezing. From the experiments in open water it was found that the variations were of the same order below freezing as those under the surface ice, but the extent to which the river could become warmed through the influence of sun and rain was much larger than could be expected under the ice.

Differences of opinion have existed to a great extent among observers in regard to the temperature of the river water in winter. Mr. Kennedy has charts of air and river temperatures for three years, taken for the Grand Trunk Railway by the late T. D. King, at Victoria Bridge, under the surface ice. There are recorded variations of temperature of the water amounting to several degrees below freezing to several degrees above. It is not known to the writer how the measurements were taken, but as these variations are very large and are not found to correspond with the atmospheric changes, they suggest possible errors of observation. Since then a number of observers have expressed the confident opinion that the river water in winter is cooled considerably below freezing. In one case an observer had noticed on very cold days the water in the river above the Lachine Rapids at the mouth of the waterworks to be in general 32° F., and sometimes 31° F., down to a depth of 20 feet. Here again no details have been given as to how the measurements were taken, or what methods were adopted for reading the thermometer in a cold atmosphere. It is important for observers, who have actually found large differences from the freezing point, to state clearly how the readings were obtained, since from Mr. Sproule's measurements and those of the writer's no considerable variations could be detected.

With special laboratory precautions it is undoubtedly possible to cool water, free from ice and dissolved air, to several degrees below freezing, without the formation of ice. On the slightest agitation, however, or on the introduction of the smallest crystals of ice, there will be formed all through its mass long needle crystals of ice in sufficient quantity to bring the mass of water to the freezing point. It will then be found impossible to further cool the mixture of ice and water so long as any water remains.

Ice and water can exist together only at the freezing point. If heat is abstracted from the mixture there is apparently an isothermal change of water into ice, and if heat is supplied to the mixture there is apparently an isothermal change of ice into water. From theoretical reasoning a large temperature difference between ice and water in the same solution could not possibly exist. It seems impossible then to imagine a flowing river, either with surface ice or mixed with frazil, to be cooled appreciably below the freezing point. The small differences observed by the writer would, however, appear to indicate that the process, although apparently isothermal, is in reality dependent on small temperature changes. This has already been claimed by some authorities, and the results of investigation have been to indicate that the temperature of a mixture of ice and water to a certain minute extent depends on the relative amounts of ice and water present and whether the mixture is rapidly freezing or thawing. The fact that under surface ice, on a sudden drop in air temperature, the water commenced by being in a slightly undercooled state, and then as the ice grew and the proportion of water became less, the temperature came nearer and nearer to the freezing point, would tend to support this view. Of course these variations are exceedingly small, and could only be detected with very delicate apparatus. They would not be noticed on a thermometer reading only $\frac{1}{100}$ of a degree.

The idea will immediately suggest itself to the reader, whether or not these small differences observed by the writer could have originated in the artificially prepared mixture of snow and water containing the steady end of the thermometer. It would be out of place here to go into details over the many precautions necessary to avoid errors of this kind, but it may be said that it is possible, within the limits of these measurements, to prepare mixtures which will be sufficiently uniform.

Larger temperature differences may very probably exist in quiet water where there is little or no ice, but the more water is being churned up and mixed with air and ice, the less can its temperature be cooled below the freezing point. It was, therefore, almost certain, *a priori*, that the temperature of the river water in the rapids could not differ materially from the freezing point. Nevertheless it is satisfactory to have been able to demonstrate the fact by direct observation, and at the same time to detect such small variations as should theoretically be due to the rate of formation or dissolution of the frazil.

Previous observers have differed a good deal in regard to the way in which they have explained the appearance of river ice. The terms "Frazil" and "Anchor Ice" have been used synonymously, and are apparently often understood as the French and English for the same thing. From the report of the Montreal Flood Commission, published in 1890, which is undoubtedly the highest authority on river ice formation which we have, it is seen that "Frazil, as distinguished from anchor ice, is formed over the whole unfrozen surface above and below Lachine Rapids, between Prescott and tide water, and wherever there is sufficient current or wind agitation to prevent the formation of bordage ice. . . ." The term anchor ice includes of course only such ice as is found attached to the bottom, but frazil is apparently frequently used to include ice formed on the bottom as well as throughout the mass and surface of a river. In the present paper the distinction indicated by the Flood Commission has been adopted, and frazil is not used so as to include ground ice.

To the writer, the formation of ice in a river cooled to the freezing point, appears to be due to two causes:

(*a*) Loss of heat by contact with a cold air; (*b*) Loss of heat by radiation. The first cause is probably responsible for the greater amount of the fine floating ice seen in our rivers whenever the current is too rapid to permit of the formation of a surface sheet. The churning up of the water in shallow rapids is simply a special case of this, in that a greater area of surface is exposed to the influence of the colder air, causing a more rapid abstraction of heat. In quiet waters subjected to a cold atmosphere, every one has noticed how long needle crystals of ice shoot out horizontally in all directions over the surface. These crystals by increasing and compacting form the first layer of surface ice. In agitated water, time is not given for surface crystals to grow to any size. On the contrary, small needle crystals are formed, the degree of fineness depending on the rate of agitation.

An experiment was carried out at McGill University, by Prof. Nicolson, which will illustrate this point. A quantity of water in a tub was kept in rapid motion under the influence of a cold atmosphere in winter. The result was that fine needle crystals of ice, in every respect similar to frazil, were formed throughout its mass, until the whole became somewhat like a thin paste. During the progress of the experiment no deviation in the temperature of the water from freezing could be detected with a thermometer reading to hundredths of a degree. In smooth, gently flowing water it is possible to have thin, flat plates of ice formed which become mixed with the finer crystals. Previous observers have noticed these plates mixed up with frazil and have endeavored to draw a distinction between the two. It does not seem necessary to draw a distinction, as these will be formed in a river ice of every degree of fineness.

Loss of heat from the water under the surface ice will take place by slow conduction through the ice, the upper layers of which must be nearly at the temperature of the air. In the experiments conducted by the writer under the surface ice, it was noticed that when the air temperature was very cold, long needle crystals would grow out which could be seen through the hole cut for the thermometer. This fact has already been noted by previous observers, and shows the tendency for surface ice to grow on the underside. The writer has seen the opinion stated that surface ice never grows in thickness beneath, but always on top. The explanation given for this is that ice is always somewhat porous and water is drawn up through pores and frozen on the surface. It is difficult to conceive how this could take place through two or three feet, how water could be drawn through a mass of ice cooled below freezing, as surface ice must be, without its becoming transformed into ice on the way. In this case the pores, if they ever existed, would soon become choked up. It has been urged as a further proof that the surface level of ice formed on a river rises, even though the water does not. This would naturally occur as the ice would be continually buoyed up as it grew deeper into the water. This force would of course act so slowly that the surface ice would move without cracking, continually adjusting itself in response to the pressure underneath.

In regard to the second cause of the loss of heat in a river, there has been a good deal of dispute. Some claim that as all the phenomena of ice formation in a river may be satisfactorily explained without the aid of radiation, it is unnecessary to introduce it at all. But as radiation exists, as is shown by Dr. Wells' beautiful experiments on the formation of dew, described by Prof. Tyndall, it becomes important to see how far it influences the formation of ice in a river. On clear days, irrespective of the temperature of the atmosphere, immense quantities of heat are radiated from the earth off through the atmosphere into space. This has the effect, as is well known, of cooling the surface of the earth, which in its turn cools the atmosphere. During cloudy weather the heat radiated from the earth is reflected back again by the clouds, so that under these conditions the earth does not become cooled. From Tyndall's experiments on radiant heat, it is seen that heat rays may be passed to a certain extent through clear water or clear ice. He beautifully illustrates this by heating platinum red hot in the sun's rays, concentrated by a lens of ice. There is no reason then why the bottom of a river should not radiate heat straight through the water and atmosphere into space. Then the bottom will become cooled below the temperature of the water, which in winter is at the freezing point, and ice will be formed *in situ* by the abstraction of the latent heat of the water in immediate contact. The process of thickening will take place by radiation from the surface of the ice itself. Radiation from the bottom will be, of course, greatly hindered by the granular texture of the ground ice, and when it becomes so thick as to prevent any further radiation, or on a cloudy day, not sufficiently cold to produce undercooling in the water, heat slowly conducted through from beneath will melt off the hold which the anchor ice has on the stones and rocks.

Engineers have held that heat conducted through from beneath must help to keep up the temperature of the river, and that stones could not become cooled below the freezing point on account of this. One observer says: "How then could a stone, whose upper surface is at, or almost at, 32° F., and whose lower surface is at a somewhat higher temperature, radiate cold into a body of water from which it is itself receiving cold?" From the results of the observations on soil temperatures which have been carried on now for several seasons at the McDonald Physics Building by Prof. Callendar, in conjunction with Prof. McLeod, with delicate electrical thermometers placed at different depths in the ground, it has been shown that the conduction of heat through the earth from beneath is exceedingly slow. It may be easily calculated from the results of their work that the amount of heat which would be conducted through the earth to the bottom of a river in one hour, would not be sufficient to melt a layer of ice more than 1-500 of an inch in thickness.

It is very improbable that ground ice could be denser than normal, and therefore prevented from rising, as some observers have thought. There are certainly no experimental data to support such a supposition. On the contrary, the growth of the crystals in a mass of anchor ice is as far as possible in a vertical direction, showing that the ice must possess buoyancy even as it forms. This no doubt gives rise to the beautiful tree-like forms of masses of ice on the bottom, resembling the weeds in summer. Where a river is flowing very gently and smoothly a surface layer of ice forms, which becomes covered very soon with a layer of snow. This layer of snow will act as a check to radiation, hence the well-known fact that anchor ice does not form under a layer of surface ice. There is another possible reason why in deep, gently flowing rivers, ground ice is not readily formed. Below 39° F. it is well known that warmer layers of water sink to the

bottom and colder layers rise, so that the bottom of a deep river may be above 32° F. As a matter of fact the writer found the water under the surface ice slightly warmer at a depth ; otherwise there seems to be very little reason why ground ice should not be formed under a layer of clear surface ice.

There is very little doubt that the immense thickness of several feet which anchor ice attains must be due, partly, to the sticking of surface formed ice carried down by currents which are continually shifting in a rapidly flowing river. The branching form, in which anchor ice grows, would tend to entangle and collect the floating ice. This sticking together of the ice was only noticed by the writer when the water was in a very slight undercooled state, caused by excessive abstraction of heat. The two principal atmospheric conditions for producing this effect the writer considers to be a dull, cold stormy day with wind, or a clear cold night. When measurements were being made of the temperature of the water in this state, in a shallow part of the rapids near the shanty, the stem of the thermometer was placed on the surface of some ground ice, which could be distinctly seen through the water. In a very short time the stem was frozen down, and could only be removed with great difficulty without injuring it. It is interesting to state that the writer was actually observing a small difference below freezing during the time the lower portion of the stem was becoming attached to the bottom. During this time immense islands of ice appeared in the shallower parts of the rapids, apparently growing by the attachment of frazil carried down by the currents. The river was of a dull, sandy color, as though full of ice. The whole tone of the river seemed different to that on a similar dull mild day.

Mr. Keefer, former president of the Canadian Society of Civil Engineers, in the discussion following G. H. Henshaw's paper on "Frazil," published in the transactions of that society, for March, 1887, gives an observation made by himself, which accords well with the one made by the writer. He has noticed that while crossing the St. Lawrence, opp site Montreal, in a canoe, when the thermometer was below zero, and when there was no floating ice, the water, instead of being clear as usual, was lead-colored, thick and "sandy" with ice. He further goes on to say that "spicules of ice, about the size of darning needles, attached themselves to the paddle by their points, and when it was withdrawn from the water stood out at right angles to the wood." He goes on to express the opinion that in this condition the river was loaded with ice spicules to the bottom, densely and uniformly distributed throughout the whole mass, and would supply the raw material for the formation of anchor ice at the bottom, when the latter was prepared to receive it. In this condition the writer thinks that had any ice been already formed on the bottom by radiation, then the lower layers of these ice spicules would have become entangled and subsequently attached.

Regelation has been proposed as an explanation of the way in which ice sticks to the bottom. This is very improbable, for there is quite a difference between the coalescence of ice particles by continued pressure, which cannot take place between ice and any other body, and the freezing together of ice crystals due to a natural growth on their surface. Even during very cold weather the sun has an enormous influence in determining the temperature of the river water. Its rays undoubtedly penetrate to the bottom and melt off the anchor ice. The writer has frequently noticed in the morning that, after a cold, clear night, beyond the amount of frazil floating down in the currents, there was no other ice visible, while as soon as the sun became brighter and more powerful, large masses of anchor ice were brought up from the bottom and floated down. Mr. Keefer states that mill owners never find any trouble from the formation of anchor ice, no matter how cold the air is, if the sun is shining, and also if there is a cloudy sky at night. This again points to the formation of anchor ice by radiation.

In order to test the effect of radiation in the water, the writer arranged some experiments by which it was made apparent on the stem of the thermometer. During the day, when the sun was shining, it had always been noticed that the water was a little warmer than freezing, even though the air temperature was considerably below freezing. The writer found that by placing the thermometer at different depths in some comparatively quiet back water near the shanty, the upper layers of the water were always warmer than lower layers, and if the thermometer stem were sheltered from the direct rays of the sun, it showed a still lower temperature. The water within eight inches of the surface was apparently considerably warmer than freezing, although the air was very cold. No other explanation of this could be given, except that the sun's rays were radiated through the water and were warming up the stem of the thermometer itself.

Experiments were also tried to test the effect of having the thermometer actually cooled by radiation. These observations had to be taken during a very cold clear night. The result accorded closely with the expectation. The details of these observations would perhaps be somewhat beyond the scope of the present paper, but the writer hopes elsewhere to be able to give the actually observed differences of temperature in support of these assertions.

It will be of interest here to give two examples which have come under the writer's notice, the first one by direct observation and the second one through Mr. Kennedy, which will serve to illustrate the tremendous power exhibited by frazil during the time when it is agglomerating. Engineers have found this to be the most destructive state for the frazil to be in. It has been already shown that this is probably due to the temperature of the river being very slightly below freezing. During the course of the winter quantities of frazil are being manufactured in the Lachine Rapids and swept under the barrier ice by the swift currents. This frazil on reaching quieter waters soon rises and becomes attached to the underside of the surface ice. If reference is made to the report of the Montreal Flood Commission, it will be seen on the charts made of the cross sections of the river at different distances below the rapids how, the nearer the section is to the rapids, the greater the area of ice and the less the free waterways, while the further away, the less the total area of ice and the greater the channels. During a severe cold spell it would not be difficult to imagine the free waterways becoming completely choked up. This apparently occurred during the past winter, for during a severe storm about the end of January, the level of the water rose, and by increasing the head produced a shove.

It is well known how the Ottawa and St. Lawrence Rivers meet at the head of Ile Perrot and flow around the island into Lake St. Louis, the Ottawa on the north side and the St. Lawrence on the south side.

For a long way the waters do not mingle, but flow side by side. The Ottawa River has also another course around the Island of Montreal. During a continued cold spell so much frazil is made in the open water of the St. Lawrence, just before it enters the lake under the surface ice, that the channels become almost completely blocked. The water is consequently forced around the head of the island into the Ottawa River channel. This in turn forces the Ottawa entirely into the back river course. The Montreal waterworks obtain water on the north side of the river above Lachine rapids, and under normal conditions receive almost entirely Ottawa River water. When the Ottawa is forced out of its channel and its place taken by the St. Lawrence, the fact is made apparent by the difference in color of the tap-water in the city.

In conclusion, a great deal might be said about frazil, with reference to the construction of hydraulic works, but as the present paper is simply an explanation of the appearance of river ice in its many forms, from the point of view of a physicist, the rest will be left to those more competent to deal with that side of the question.

As in northern countries it will be impossible to prevent the formation of frazil ice, it becomes the duty of the engineer to make a careful study of the facts attendant on its manufacture and agglomeration, and to apply such knowledge intelligently. As we continue to grasp more and more the true scientific nature of river-ice formation, we may hope, not without reason, to find possible methods for tempering its effects. The practical advantages to the industries of the country derived from such a result would be incalculable.

For THE CANADIAN ENGINEER.

ANYONE CAN ASSAY.*

BY ALEX. ROY, TORONTO.

[The following easy method of making a test for gold is the cheapest and most convenient of which we know. The instructions must be followed with precision, and to attain good results, a certain dexterity in handling the materials is necessary; but this may be attained by practice.—ED.]

MATERIALS.

The actual requirements for finding out if an ore carries gold, are :—

A good hammer.
A few crucibles.
A few cupels.
5 cents worth of litharge.
5 " " washing soda.
5 " " cream of tartar.
5 " " nitric acid.
A small quantity of salt.

This amount will make half-a-dozen assays, and the materials can all be carried in a small grip. Cupels are made of bone ash powdered up as fine as flour. This can be bought for about twenty cents a pound, and one pound will make about forty, and can be carried in a small pepper-box, packed inside with paper to prevent their being broken. Litharge can be got at any village drug store. Cream of tartar or washing soda can both be found in any farmhouse, as also salt.

The usual method of prospecting is to arrange board for a week at a farm house, except in uninhabited districts where camping is necessary, and prospect around a day's walk in different directions, then go on to the next place. Gold can be looked for to advantage in the neighborhood of any reported discoveries. The writer has made assays of gold ore from almost every county in Ontario north and east of Lake Simcoe and Peterborough, all of which showed more or less gold.

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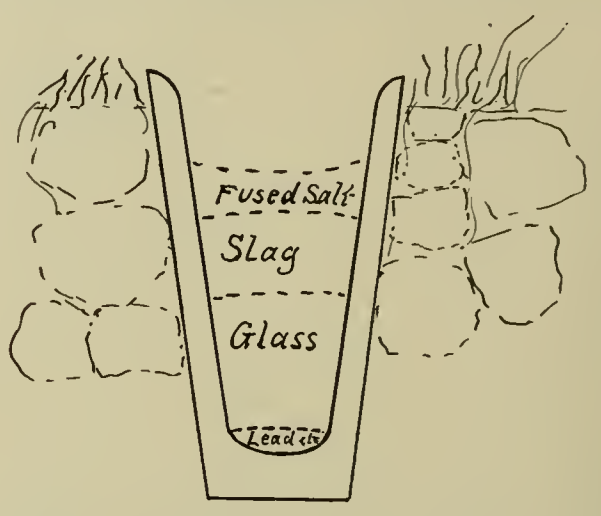
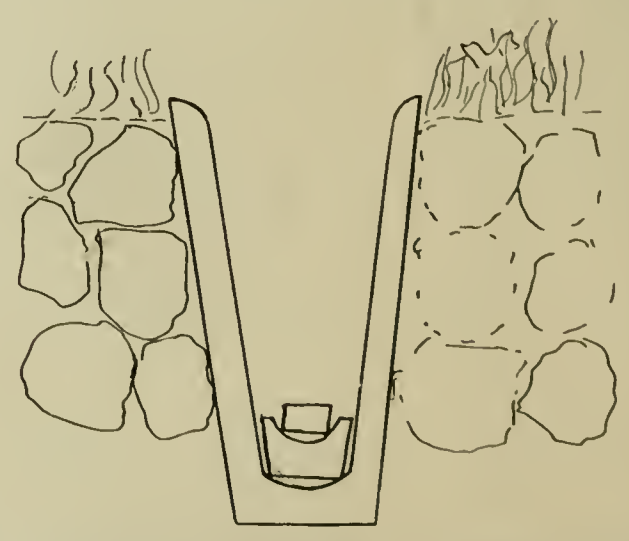
PROCESS.

Pound up the ore to powder and mix it up well, then shake it so as to make any heavy gold fall to the bottom, then take one tablespoonful (= one ounce), or for accurate work 1 ounce, and lay it on a piece of paper, then take a tablespoonful of washing soda (= one ounce) and mix it with the ore, then a teaspoonful of cream of tartar ($\frac{1}{4}$ or $\frac{1}{2}$ ounce) and mix it in with the other two, and add a tablespoonful of litharge (two ounces) and mix it with the rest. Then pour the whole



of it into the crucible, cover it with salt $\frac{1}{2}$ inch in depth, and place the crucible in a good fire so that it can get white hot. Let the contents melt into a liquid and then take the crucible out and gently tap it on something to shake the lead, etc., down to the bottom. Then let it cool and break the crucible. At the bottom will be found a piece of lead about the size of a coat button and of the same shape. Take this out and pound it up into a cube or little square block, so as to get all the sand and other stuff out of it. Then take a clean crucible and place it in the hole in the fire that the other one was taken out of. -Place the cube of lead in a cupel, and lower it into the crucible with a thin strip of paper. Let it get quite hot or until it begins to fume or give off a little white smoke, and let it keep doing this for about an hour. It will gradually all grow smaller, until there is only a very small bead of it left which won't pass off. Take a small piece of silver (a shaving off a five-cent piece will do), and drop this on this bead and let them melt together; take out the crucible, and let it get cold. Then take out the bead very carefully and lay it on a piece of flat iron, and press a hammer down on it till it



is flat. Place it in a small vial, or bottle, or a tea cup, and pour a little nitric acid on it and heat it a very little. If there is only silver present it will all melt up in the acid, but if there is gold, there will remain a small black flake, which will reveal its true character by rubbing it with a knife.

This is all that a prospector requires to know, as if

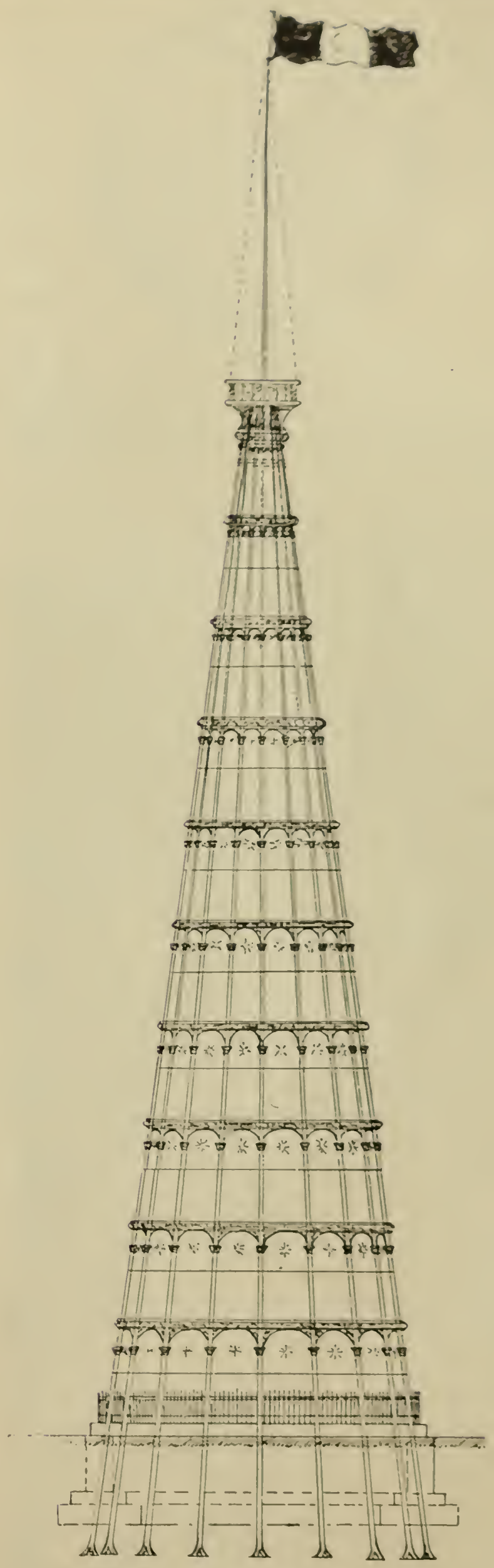
a mine shows gold at all it is worth something to the man who finds it. Any mine that shows gold under this test will run over four dollars a ton, and any mine showing this amount will pay to work it. Assays running over $15 per ton are not average assays, and not to be depended on. The prospector need not expect to find the gold sticking on in lumps; it does not occur in that form very often. Liquid tests, as a rule, can only be made by expert chemists.

If the ore contains a small amount of arsenic, it cannot be tested by this method, as the arsenic would carry all the gold off with it in the form of vapor. The arsenic can be detected by heating the ore, when the arsenic is given off, and can be recognized by its smell, which resembles garlic. All ores containing a large amount of pyrites will have to be roasted before assaying. Ores containing arsenic can only be tested by an expert analyst, as I have myself seen ores which went as high as fifteen dollars in gold show nothing when tested by assay, so when an arsenical ore is met with, if it does not show gold by this process it should be analyzed. Gold when found in a free state is only in very small white-yellow grains, hardly visible under a magnifying glass. If the capping rock of a mine shows a large amount of iron or rust, it must have a little sand mixed with it to form a good slag. Other little points the assayer will find out as he goes along.

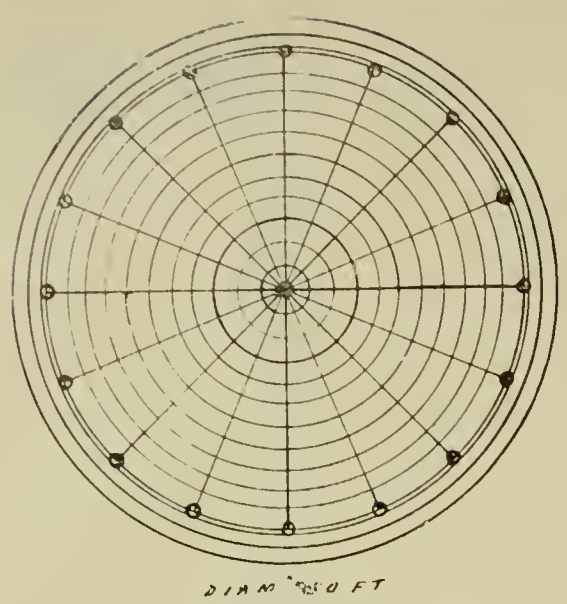
PROPOSED VICTORIA JUBILEE TOWER FOR QUEBEC.

Charles Baillairge, city engineer of Quebec, has recommended to the city council the construction of an iron tower 150 feet high on the Place d'Armes, as a memorial of the Queen's reign. This would be 50 feet higher than the loftiest point of the Frontenac Hotel, the top having a "crow's nest" 10 feet in diameter, surmounted by a flagstaff, having a flag with the word "Victoria" worked into it. The structure, of which a plan is here presented, could be built very cheaply. and the effect of the fireworks and illuminations from such a tower are vividly and dramatically pictured by Mr. Baillairge, as follows:

"The crow's nest on the now proposed pyramid would afford a commanding view of the whole surrounding country, and in the case of an illumination with fireworks, a hundred rockets or more set around its periphery or two or three hundred of them in double or treble tiers, all slightly inclined outwards at an equal angle to the vertical, if simultaneously or together fired by electricity, and soaring skyward another hundred and fifty feet or more, would thus form a sheaf, a monster parachute, opening at some 600 feet above the St. Lawrence, and their component vari-colored stars lighting up the heavens and descending in a fiery shower upon the city, not this time out of God's wrath, as on Sodom and Gomorrah of old, but as a shower of blessings for a munificent reign of 60 years of good and noble deeds. Such a structure would be used on all festive occasions, each of its 160 arches lit by an incandescent light at night with a 10,000 candle power arc light at its summit, or a 100,000 c.p. one, if the city could afford it. Creeper roses might be made to grow around it, and in time to almost cover it, or at any rate it could be festooned with artificial flowers and a bouquet hanging from each of its component arches, diminishing in size as they ascended. On a gala occasion, its usually white drapery could be supplemented to form the 'red, white and blue' of the British, the



PROPOSED
VICTORIA TOWER
QUEENS JUBILEE
SCALE 16 FT. = 1 INCH
150 FT. HIGH



'tricolor' of the French; while on a day of national mourning, as when we lose our beloved Sovereign, it may be painted and draped in black or white and black, or all in white, as on the birth of another heir to the throne."

THE MOTOR VEHICLE—IDEAL AND REAL.

Regular readers of THE CANADIAN ENGINEER need not be told that this journal is interested in the new development of inventive industry in connection with the autocar or horseless vehicle, and that we have faith in the outcome of inventive efforts along this line. Since the editor returned from England last autumn, and wrote his impressions, we have published nothing special as to motocycles, for the very good reason that no radical improvement has since been made. We think our readers may be interested in a review of the situation as it is at present, gathered from the various journals of the motocycle industry, from the published data as to tests, and from interviews with practical mechanics and electricians who are wrestling with the knotty problems involved.

Let us first say that the essentials for motocycle work are: (1) power, (2) control, (3) speed. These essentials are given in the order of their relative importance. *Power* must be sufficient for overcoming hills and holes, sand and snow, rain and ruts. The power required on a good level road for 2½ tons of vehicle and load would be about 2.5 horse-power for a speed of eight miles an hour, or about 3.75 horse-power for a speed of twelve miles. To mount a hill, some parts of which may be on a gradient of 1 in 20, the 2.5 horse-power rises to 10.5 horse-power; but if a speed of three miles per hour were deemed sufficient for climbing the gradient of 1 in 20, only about 4 horse-power would be required. But for bad roads these quantities ought to be doubled, so that to take 2½ tons of vehicle and load up a gradient of 1 in 20, at eight miles an hour, would require about 20 horse-power, or at low speed about 8 horse-power. These conservative figures, taken from an English engineer, should be kept constantly in sight by inventors; and it might be added that even on ordinary level roads there are occasional short grades much steeper than 1 in 20, whereas sidewalk crossings run 1 in 10. *Control* is important both as to speed and as to steering. In the Chicago contest one motorman became unconscious because of the great strain of manipulating the steering apparatus. *Speed* is the third element, but has no value except in conjunction with power and control. The more speed we get, the more urgently must we insist on control. High rates of speed may be permissible, even advisable, with an extremely perfect control; and it is possible that a method of control may be yet secured that is even more tractable than a horse; but it is not here yet. The control of electric vehicles, not being limited to fixed speeds, is preferable to that secured by differential and frictional gearings, both of which are antiquated, though the latter is advertised as a novelty. The practical difficulty with frictional gearing on an autocar is that there is insufficient grip when it is most needed, viz., when special demand is made for power.

The motive powers which have been tested on autocars may be named in order of merit: (1) *Explosives*, including petroleum, acetylene and gunpowder. (2) *Electricity*, primary and storage. (3) *Steam*. (4) *Compressed Air*.

It is next to impossible to get reliable data on autocars. Readers must winnow a bushel of chaff to get one kernel of wheat. The only really reliable mechanical data we have is that furnished by the judges in the *Times-Herald* contest in Chicago last November. The Duryea gasolene motor made the highest record on practically all points, and we may, therefore, take this as high-water mark up to date. What do we find? The vehicle (seating two persons) weighed 1,208 lbs.—and this, by the way, was the lightest of all the vehicles entered. Two runs were made with her on the testing machine, giving draw-bar strains of 83 and 88 lbs. respectively—these being the records of the motor while running under its best conditions. At these draw-bar strains, 1.10 and 1.16 horse-power was exerted at the rim of the driving wheels, at a speed of less than five miles per hour; a mechanical efficiency of 65 per cent.; a consumption of 3.64 and 3.24 lbs. of gasolene per h.p. per hour, giving a cost per h.p. hour at rim of wheel of 7.28 cents and 6.48 cents. As the Chicago judges remarked: "It is apparent that the heaviest pull exerted, namely, that with the Duryea vehicle, amounted to only 187 lbs., as compared to 400 lbs. which a single horse could exert. . . . For the purpose of determining roughly a probable value, an express horse of average type was tested by your committee, and without resorting to violent methods of persuasion, the maximum pull obtainable was found to be about 250 lbs. It is probable that 400 lbs. is about the maximum of a good horse. On the other hand, when the pull is light a considerable range of speed may be obtained, and the measure of the power exerted by the horse at all times may be obtained by multiplying the pounds pull by speed in feet per minute; dividing this by 33,000 gives the ordinary unit known as a horse-power." Taking this method of calculation with the Duryea motor, the best result is about half the draw-bar strain that a good horse could exert.

It is quite evident from the above figures that although the price of motor carriages ranges from $1,000 to $1,500, their actual efficiency for work on roads other than asphalt is less than that of a horse which could be bought for about $25. The only hope of popularizing the horseless vehicle, at least for the present, is by producing something infinitely better than an ordinary horse.

As to acetylene and gunpowder, these are two very desirable fuels if they can only be kept reasonably cheap, but thus far the indications are against this.

As to electricity from storage batteries, there are many advantages such as cleanliness, simplicity of manipulation and control, absolute safety, and absence from vibration: but as shown by the Morris & Salom

vehicle at the Chicago test, the difficulty is the low margin of power-supply, and the uncertainty of being able to accomplish your journey unless charging stations are established along the route.

It seems absolutely cruel that in an up-to date article on the latest development in autocars we should have to mention steam; but many enthusiastic and intelligent autocarists, particularly in England, are proclaiming its superior merits, the Serpollet system being the prime favorite with the cult led by Sir David Salomons. The advantages of steam are, first, no trouble with igniter; secondly, a well-fitted steam engine is one of the most reliable machines made by man. The disadvantages relate to the boiler—danger from explosion, size, difficulty of keeping clean, the large amount of water to be carried, and the visible nature of the exhaust.

Compressed air has largely the advantages of the storage battery, with its most serious defect—lack of sufficient storage capacity. It has, however, all the advantages of the steam engine in its ease of control and certainty of operation, while it is absolutely free from all odors, and vibration can be reduced to a minimum. But the great difficulty and cost of supply, large bulk of reservoirs, and danger from explosion, put this power out of the race, at least in the meantime, except for very short services.

To sum up: there is not to-day, so far as we can learn, a single vehicle motor anywhere working under any of the systems above named, which can show an efficiency equal to that of good horseflesh for every-day work on all classes of roads. There need be no trouble from slipping when pneumatic tires are used; but we would impress on inventors that they should pay less attention to speed and more to the development of power so as to suit actual roads, and not ideal ones, under the impression that the roads will be made to suit the vehicles. The motocycle will be an important factor in bringing better roads, if it can be made to do effective work on present ones.

The difficulty of securing reliable data sufficient for this article has been so great that we can readily understand why the motor vehicle industry is now practically at a stand-still, the public having been disheartened by the great disparity between claims made by inventors and actual performance; but the best proof that motor vehicles are not yet on a commercial working basis is the fact that they are not doing work on our streets, and that first class opportunities, such as that offered by Elder, Dempster & Co., for the carriage of goods from Liverpool to Manchester, go a-begging.

For THE CANADIAN ENGINEER.

CARE AND ERECTION OF SHAFTING.

BY G. P. CLAPP, MONTREAL.

A few simple rules for the erection and maintenance of line shafting may be interesting to manufacturers who are looking for strict economy and the best results obtainable in this department. In erecting new shafting, adjustable hangers should be selected, and strong enough to do the work required without springing. The width of bearings should be three times the diameter of the shafting. Where a number of pulleys and belts are used, bearings should ordinarily be ten, eleven and twelve feet between centres, for 2, 2½ or 3 inch shafting.

When large driving belts, from six to twelve inches wide, are to be used, a strong bearing should be placed on each side of the pulley. A neglect to provide for this important item will result in springing the shaft, and causing it to heat in the bearings, besides the liability of breaking from the constant vibration and eccentric motion, which always occurs when shafting is sprung out of line by stress of tight and heavy belting. Shafting should not be fully lined up until all machinery on upper floors is in position. When hangers are attached to floor timbers or ceiling, and the floors are then loaded down with machinery or material, the shafting will always be found badly out of line from the effects of springy floor and timbers. By all means avoid making a storehouse of buildings where line shafting is extensively used.

When convenient, shafting should be hung on posts having a good foundation in the ground cellar and running directly through the various floors; by this plan the floors may be sprung by varying loads and still the shafting will not be effected. Tallow or grease of any kind should never be used on bearings unless it comes in direct contact with the shafting. Piling grease on the box of a vertical shaft, stuffing it in the oil holes, or in the recess around the oil holes, in the caps of horizontal shafting, is a delusion and a snare. Only the grease that comes in direct contact with the shaft will melt until shaft and bearings become so hot that damage is done. The person whose duty it is to look after the shafting, will usually depend upon the grease doing the work that he should do with his oil can. Where the writer is employed, no one is allowed to use grease as cited above, without risking his position. More damage has been done to shafting and bearings by this practice than by any other known.

The size of shafting in its relation to its liability of heating and springing is one of great importance. Shafting too small for the work required leads to bad results, not simply from the width of bearings and size of shaft. Insufficient bearings, with a heavy tension on belting, causes the shaft to spring, and this brings the greater part of the strain on the edge of the bearings nearest the tight belt, consequently heating and cutting is the result. Writers on this subject often overlook the fact that there are other causes for hot bearings besides narrow boxes and small shafting. The fact is, bearings are not likely to heat providing oil can be kept between the two metals composing the shafting and bearings. With small shafting and tight belts, so much strain in proportion to the size of the shaft is brought to bear upon the bearings that the pressure makes an oil-tight joint, and the oil failing to penetrate between the two metals, heating is the result. If any good lubricant could be kept between the metals, heating would be almost an impossibility, but when the pressure becomes so great that the lubricant is excluded by an oil-tight joint then the trouble begins. The best and most economical results are obtained by running the main, or driving shaft, at as high a rate of speed as is consistent with safety. Experience teaches the fact that the source of power, such as engines and water-wheels, should be driven at the highest convenient speed. The following memo. for the proper size of shafting to transmit a given h.p. at varying speeds, may be interesting to some of your numerous readers. Size of shaft $1\frac{15}{16}$ in.:

Speed of shafting	100	125	150	175	200	225	250
H.P. developed.. ..	10½	13	16	19	21	24	26

We are glad to be able to announce that the Ontario Government has refused the extension of time asked by the Canadian Niagara Power Co. to complete their power works on the Canadian side of the Niagara River, and work was commenced on the 30th April. The question of the status of the company in relation to other companies requiring power from the Niagara has been referred by the Government to the Court of Appeal, as also the question of the bearing of the Dominion charter granted to the Canadian Power Co. (the Welland River) on the American syndicate.

THE OTTAWA WATERWAY TO THE GREAT LAKES.

BY A. J. FORWARD, OTTAWA.

For THE CANADIAN ENGINEER.

In *Scribner's Magazine* for January, 1896, a New York writer quotes approvingly the proposition of L. E. Cooley that "the line of export must follow the line of domestic transportation," and infers that "whatever merit Canadian routes may have from an engineering standpoint is entirely overbalanced by the fact that they run through a district which can furnish but very little freight in either direction." The fallacy of this statement, so far as regards the Ottawa route, may be readily shown.

During the season of 1895 the traffic of the Erie Canal, both eastward and westward, originating in New York State, was in the neighborhood of 600,000 tons, of which the following were the principal items: Pot and pearl ashes, 11,495 tons; barley malt, 24,698 tons; salt, 66,460 tons; stone, lime and clay, 240,859 tons. The quantity of coal distributed was 469,595 tons. Wheat from Buffalo and Tonawanda to points along the line of the canal amounted to 71,850 tons. From 1890 to 1894, inclusive, the movement of freight was as follows, according to New York Chamber of Commerce reports:—

	From Tide-Water. Tons.	From Western States. Tons.	From New York State. Tons.
1890.....	1,304,274	1,194,017	470,549
1891.....	1,175,536	1,186,521	502,589
1892.....	1,120,704	1,329,706	478,380
1893.....	567,659	1,586,238	675,380
1894.....	960,320	1,437,293	259,059

The average annual traffic of the Erie Canal originating in New York State, or in other words, "derived from the district through which it passes," was therefore, during that period, only 473,191 tons.

For the period 1883-'93 inclusive, the average traffic of the Ottawa canals amounted to 692,173 tons.* Practically the whole of this originated along the Ottawa River, and the bulk of it was lumber. In 1894, out of a total traffic in that year of 562,010 tons, no fewer than 548,747 tons were the produce of the forest.† During the same year, out of 886,778 tons moved on the St. Lawrence, exclusive of the Welland, 537,982 tons were through freight, leaving only 348,796 tons as the traffic of local origin. From these figures it appears that the lumber traffic alone of the present Ottawa canals exceeds the entire traffic of the Erie canal derived from New York State, and is double the local traffic of the St. Lawrence canals. Such being the case when the canals extend westward no further than Ottawa city, it is reasonable to expect that the locally-derived traffic of the completed waterway, passing through the heart of the lumber country, and giving an additional outlet westward to Chicago and other lake markets, as well as better facilities to the east bound trade, will be at least twice or three times as great as that of the Erie Canal, without reckoning on anything else but lumber and other products of the forest.

The output of sawn lumber from the Ottawa district for 1895 was estimated at 627,000,000 feet. This at 600 feet B.M. to the ton, would amount to 1,045,000 tons. In 1892 the Georgian Bay region exported 184,500,000 feet of sawlogs, or 307,500 tons. Last year 307,000,000 feet (estimated), or 511,666 tons, went to the United States from that quarter. An open waterway from the lakes to the foot of Lake Tamiscamingue would result in the establishment of mills on the route to saw lumber for export to lake markets. A largely increased cut of timber would result, and the provincial revenues be correspondingly augmented without any injurious drain on our forest resources. Henry O'Sullivan, Inspector of Surveys for the Province of Quebec, in his report of surveys on the Upper Ottawa in 1895, says: "If there were mills on the spot, or if easy access could be had to this region, a great deal of good timber that is now left to rot could be utilized; but when we consider the distance, some seven hundred miles, that this timber has to be driven to Quebec market, second quality stuff cannot pay." Hardwoods, which cannot be floated for long distances, and inferior sorts of timber, would at once become merchantable, and go to swell the annual output, which it may be safely asserted might be doubled without trenching to any greater degree on the stock of pine of the better class. Where there is cheap transportation, such as the waterways would afford, the by-products of the forest are in the aggregate of greater value than the lumber and timber annually cut. Pulp and pulp-wood alone will furnish a large carrying trade. The market is extensive, and rapidly growing. European countries import over 500,000 tons of pulp annually. The report of the New York Forest Commission, 1891, states: "In the last eight years the amount of timber used for this purpose has increased 500 per cent. In 1891 the timber cut for wood-pulp in the great forests of Northern New York was equal to one-third the amount cut by the lumbermen. Already the cry of scarcity of pulp-wood is being raised in the United States, and they must soon come to Canada for almost their entire supply. On the head waters of the Ottawa, and northward over the height of land, are inexhaustible stores of spruce and poplar of the best quality The conditions for its local manufacture are also of the best. Three things are necessary to success, suitable wood, extensive water-power, and cheap labor. All these, as well as cheap transportation, will be found along the Ottawa River. Firewood to the extent of 1,064,812 tons was carried on Canadian railroads in 1893, and would furnish considerable traffic on the Ottawa. Tan bark, hop poles, telegraph poles, railway sleepers and ties, stave bolts, posts, pot and pearl ashes, manufactures of wood, etc., along with various minor products of the forest, would each afford a material addition to the traffic.

Without counting, however, on any increased output from any of these sources, there would be an annual traffic of 1,800,000 to 2,000,000 tons of products of the forest alone to draw from, and all "furnished by the district through which the canals run."

The opening of this waterway will aid to revive phosphate mining, and will eventually, by giving access to the markets, and reducing the cost of transportation, swell it to an industry of very large proportions.

There are two principal districts in Canada where apatite or phosphate of lime occurs. Both these are in the Ottawa Valley. The first, on the north shore of the river, consists of a belt from 12 to 25 miles wide, stretching northward through Ottawa county. Though of limited area, extending about 30 miles, so far as explored, it is notable for the richness of its deposits, both as to quantity and quality of product. The second district is in Ontario, having been developed principally in the counties of Leeds and Lanark, in the vicinity of the Rideau Canal, and covers a larger area than that on the north side of the Ottawa. Hitherto the impression has prevailed that the deposits are smaller and of poorer quality than those in Quebec. However, the report of the Royal Commission on the Mineral Resources of Ontario states: "Larger deposits have been opened up, particularly in one district, on the Quebec side thus far, but as regards similarity of occurrence and variation in quality (dependent largely upon intelligent dressing of the rock) identical conditions appear to prevail on both sides of the Ottawa. The quality of the higher grades of phosphate shipped from some of the mines along the Kingston and Pembroke Railway is as high as any produced in Canada." The depth to which the apatite extends is probably for all practical purposes unlimited. Shafts to a depth of over 600 feet still continue in good phosphate, and the vein matter, though irregular, is continuous.

* Canadian Stat. Year Book, 1891.

† Report Department Railways and Canals.

Mr. H. J. Wigglesworth, of New York, in addressing the Canadian Mining Engineers in 1895, said: "These phosphates are practically unlimited. Those who have studied their occurrence most carefully see no possibility of exhausting them. If all the population of Canada were employed there mining for ten years, the extent of the deposits would not be laid bare."

Here is evidently the basis of an extensive future industry It is estimated that every year 1,500,000 tons of phosphate are taken out of the soil of the United States by its food crops. This must be returned to the soil in some form. For want of it many farms in the Eastern States have been abandoned as worthless, and whole States that could grow 30 bushels of wheat to the acre do not now average 15. Large areas in the older portions of Quebec and Ontario have been exhausted by continuous cropping. A judicious use of fertilizers would restore vitality to the soil. The worn-out cotton lands of Georgia, by the use of artificial manures, were raised in 20 years from a value of $3 per acre to $30. The same transformation might take place in Quebec. An almost unlimited home market for this valuable product will be developed in time. If the Ottawa waterway is to carry eastward the grain of the West, there must be return cargoes for the vessels employed in the traffic. What more beneficial occupation than to convey back to the soil the fertilizing elements of which it has just been depleted by the crops exported? Chicago, Cleveland, and other lake ports will afford markets every year more extensive. The only competition in those markets would be with the South Carolina product, which is handicapped by the long and expensive railway haul across the Alleghanies and westward. Vessels by the Ottawa waterway looking for return cargoes would carry very cheaply. Buckingham, Que., would be about the same distance from Chicago by water as Buffalo.

The adverse influences affecting Canadian phosphates are chiefly:—1. Low prices in the European markets, owing to cheapness of production in South Carolina and Florida; 2. General depression of the agricultural interests and low prices for farm produce; 3. High cost of apatite mining owing to the uncertainty of its occurrence, and the expense of selection or "cobbing"; 4. Frequent rejection of shipments that fail to analyze up to required quality; 5. Excessive cost of transportation; 6. Lack of home market.

The demands of the European market have been confined to the highest obtainable grades. These are used for mixing with low grade cheap material from South Carolina and elsewhere. The necessity for obtaining an 80 per cent. grade immensely increases the cost of production, and leaves a very large part of the product at the mines as waste material. If the United States and Canadian markets were available to the fullest extent, so that at 60 per cent. grade could be shipped, the output of each mine could be nearly doubled with the same labor, and the cost of mining and handling materially reduced. The present cost per ton laid down in the English market, ranges from $7 to $14, while it is probable that if markets on this continent were to take the low grade product, it could be loaded on vessels at Buckingham, at from $2.50 to $5 per ton. It may be shipped either after simply grinding the rock, or after manufacture into superphosphates. Magnificent water-power for grinding is available at the mouth of the Du Lievre. Iron pyrites for the manufacture of sulphuric acid can be conveniently obtained. To estimate the prospective tonnage to be afforded is, of course, out of the question; but there is every reason to believe it would be large eventually. About 6,000,000 tons have been shipped from the South Carolina deposits to date. European markets import 500,000 tons a year.

Another feature to be taken into account is that mica and other minerals occur very frequently associated with phosphate, where neither alone will repay working. So that whatever helps the phosphate industry will stimulate their production as well. Mica, graphite, asbestos, serpentine, pyrites, iron, and other mineral products of economic importance occur throughout the phosphate region, and would be extensively developed by the opening of this waterway.

The principal ores of the Ottawa region are magnetic. Hematite occurs very generally associated with magnetite, but usually in small quantities comparatively. From the well-known South Crosby deposits on the Rideau Lake northward to Arnprior, and extending across the river into Pontiac county, is a region described by mining experts as a hematite and magnetic belt whence valuable ores may be obtained in large quantities. Five miles from Ottawa, four miles from excellent water power on the Gatineau River, and only two miles from a shipping wharf, is the Baldwin mine. Ore from this has been pronounced "the best car-wheel iron ever used." The vein has been traced upwards of one and a half miles on the surface, there being at one place a solid bed of ore [illegible] feet in height. The amount of exposed or easily accessible mineral has been estimated at 100,000 gross tons. Ten miles north-east of Ottawa is the Haycock mine, from which very large quantities of ore may be obtained. Thirty-five miles west of Ottawa, and about four miles from the Ottawa River, are the Bristol mines, where there is an available supply of ore calculated by their mining superintendent, Mr. Symons, at over 30,000,000 tons. A report made for the owners in 1889 by John Birkenbine, a mining engineer of Philadelphia, among other things states:

"The extent of the ore body would appear ample to encourage the installation of a plant for smelting the ore, and personal investigations impress me with the belief that the Bristol mines should become as large a producer of iron ore as any of the ore bodies which I have examined either in the Province of Quebec or Ontario. Should mining operations be carried on upon an extensive scale, the location offers some peculiar advantages, owing to the fact that four miles south-east of the mines the Ottawa River encounters a limestone ledge over which it falls in picturesque rapids and cascades about forty feet. This water power, known as the Chats Rapids, could be utilized to advantage for producing power and compressing air, which might be carried as at Quinisee Falls and Michigammee River, Michigan, to operate machines at the mines, or by converting it into electric force, it may be conveyed so as to produce power. Inspection and analysis would indicate an ore obtainable for smelting purposes approximating 60 per cent. iron, 2 per cent. sulphur, with phosphorus very much below the Bessemer limit; and when roasted this ore should exceed 60 per cent. of iron, with sulphur below one per cent. Taking into consideration the facilities now existing in the city of Ottawa, it appears to be the most advantageous location for utilizing the ores from the Bristol mines. An examination of the vicinity of Ottawa developed four very satisfactory points where blast furnaces could be located to advantage, and where facilities are offered for adding other manufacturing industries in the future. Some of these points possess special merit as to certain features, but all are convenient to transportation, and have ample cinder room, water, etc."

On the line of the Rideau Canal is the celebrated South Crosby ore deposit. Conveniently located along this waterway are also numerous deposits throughout the county of Lanark, as yet altogether undeveloped.

The numerous and rich mines of the Renfrew district and Central Ontario, and along the lines of the Kingston & Pembroke, Ottawa, Arnprior & Parry Sound, and Irondale, Bancroft & Ottawa railways, would also be very accessible from this point. Bog iron ores for mixing might be obtained from Vaudreuil, the present source of supply of the Drummondville forges. They also occur (in unknown quantities, the deposits being undeveloped) in Templeton township; in Hull township, only a few miles north of the city of Ottawa; near the river in Eardly township, 20 miles to the west; at various places along the Rideau, and throughout Lanark and Renfrew counties. Iron deposits are known to exist also in the vicinity of Lake Nipissing, on Lake Temiscaming, and elsewhere in the county of Pontiac. By means of the opening of the waterway the distance from the iron regions of Lake Superior and north of Lake Huron to Ottawa would be the same as to Cleveland.

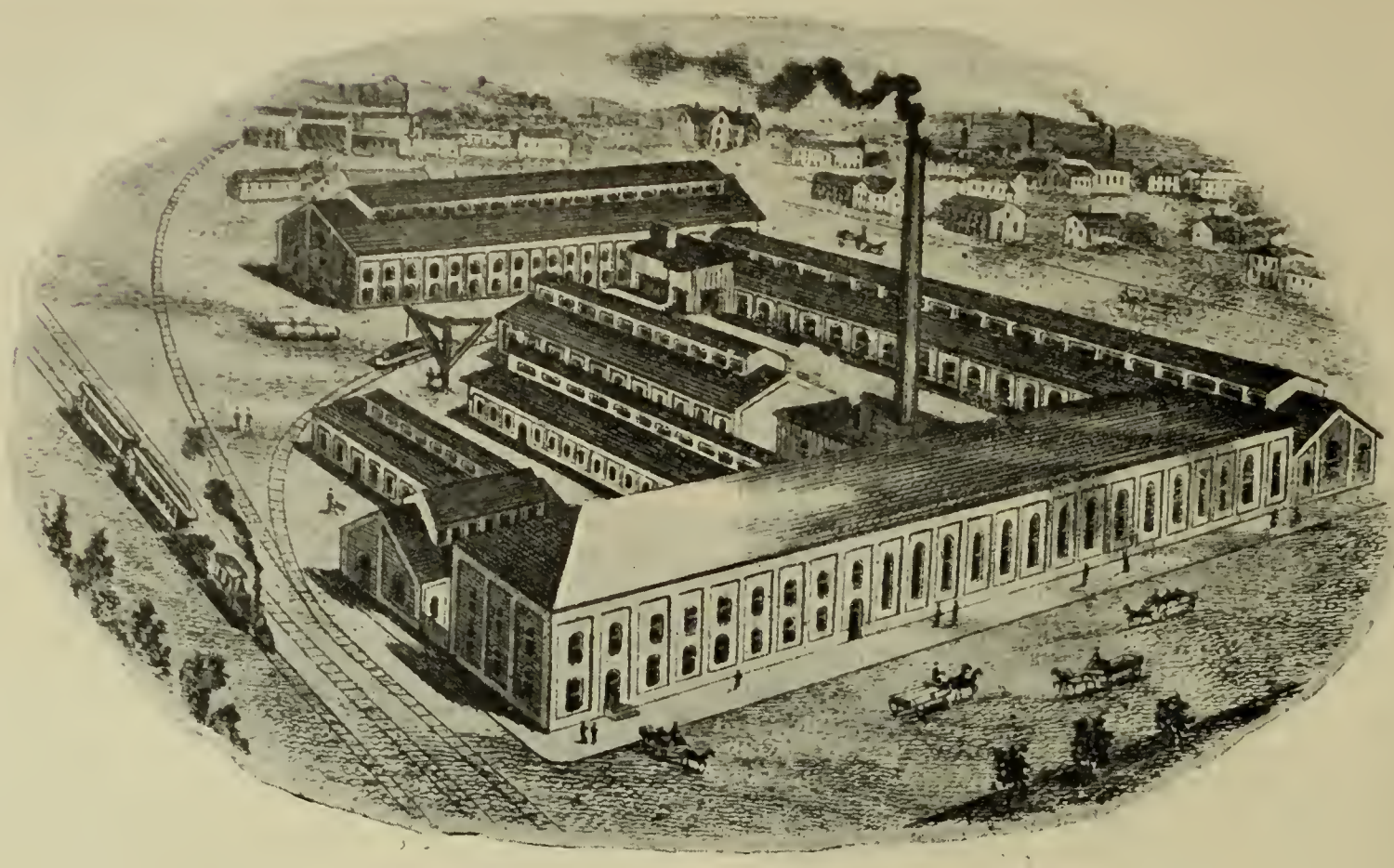
The supply of ore which may be cheaply centred at Ottawa by the various waterways and railways is practically unlimited. A writer in the *Field Naturalist* several years ago asserted that—

"We have in the Hull, South Crosby, South Sherbrooke, McNab and Marmora deposits alone, in round numbers, 1,000,000,000 of tons, a quantity sufficient to yield 1,000 tons of ore a day for 3,000 years."

A statement so purely speculative must be taken for what it is worth. What is certain is, that deposits undeniably very large are already known, that the occurrence of iron is very general over a large part of the Laurentian area in the Ottawa Valley, and that the development work and exploration thus far done amount to very little more than scratching the surface here and there.

Continued.

THE city council of Vancouver, B.C., has accepted an offer from J. A. Evans & Co., London, England, to erect a 6,500-ton smelter, as also a 250-ton refining plant. The firm is within a year to spend $600,000 on a building and plant capable of treating both lead and copper ores, and agree to employ no Chinese or Japanese. In return the city gives tax exemption for ten years, and a sufficient free public water supply. The smelter is to be of 500 tons capacity, and the refinery to be gradually, as required, brought up to 250 tons capacity. A vote will be taken on the proposal by the ratepayers.



WORKS OF S. MORGAN SMITH CO., YORK, PA.

M'CORMICK TURBINES.

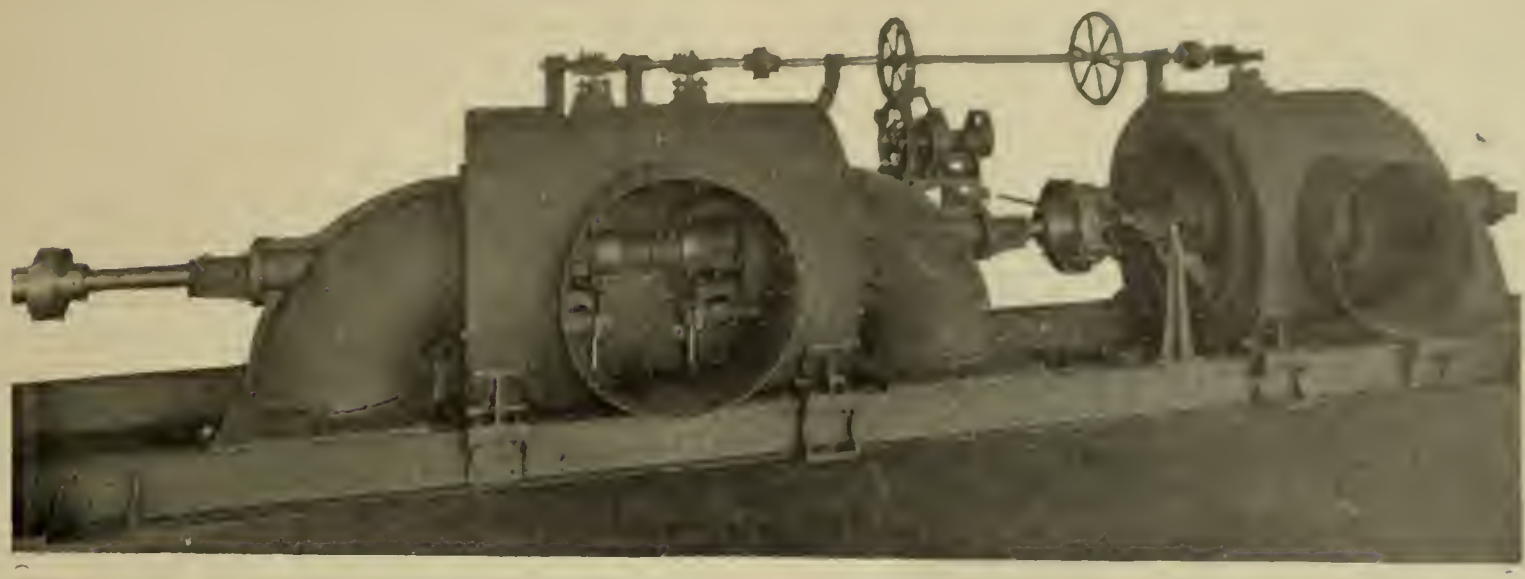
York is one of the many noted manufacturing centres in Pennsylvania, and prominent among the manufacturing plants found in that city is that of the S. Morgan Smith Company. The buildings are chiefly of stone and brick, and are more than 1,100 feet long and cover several acres of ground. This plant has been built within the past six years, and equipped with new and modern machinery. The old shops, in another part of the city, formerly used by S. Morgan Smith in the manufacturing of water wheels and mill machinery, are used by other parties for the manufacturing of different lines of oods.

The many railroad tracks travelling cranes and elevators in use upon the premises and within the buildings are so well placed that all articles of machinery manufactured, whether in their crude or finished condition, up to 60,000 pounds weight, are handled as readily as a farmer handles his ploughs upon the farm, or the merchant his goods in the store. The plant is supplied with the latest and most improved machine tools, such as boring mills, pit lathes, shafting lathes, planers, and whatever else is needed in the construction of turbine water wheels, iron flumes, shafting, pulleys, gearing, steam boilers, etc.—some of the boring mills and pit lathes being large enough to allow of pulleys, rope sheaves and fly wheels being turned off and bored out, as great as 25 feet in diameter and six feet wide upon their face. There are also some remarkably large and fine machine tools for cutting and dressing gear wheels up to 20 feet in diameter and as much as 30 inches on the face.

On looking through this shop and noting the many massive and modern tools it contains and the conveniences for handling every article manufactured, one readily understands why it is that the McCormick and New Success Water Wheels and other machinery for cotton, paper, pulp, flour and saw mills, so extensively built and sold by the S. Morgan Smith Co., give such excellent satisfaction.

The company is composed of father and three sons, who own nine-tenths of the plant. All of them are hydraulic and mechanical engineers, as well as practical business men. These facts explain why it is that the buildings composing the shops are so well constructed and arranged, why all the railroad tracks, travelling cranes, trolley lines, elevators, boilers, engines, cupolas for iron and brass foundries and great lathes and boring mills, are each and all seemingly located just in the right place. An important feature of the plant is the many windows in the ceilings and walls, flooding every department through the day with light, and at night the whole is illuminated with arc and incandescent lights, supplied by the company's dynamos. Large sums have been spent in improving and testing these water wheels, and in this way they know the speed and power of each size of their water wheels so perfectly

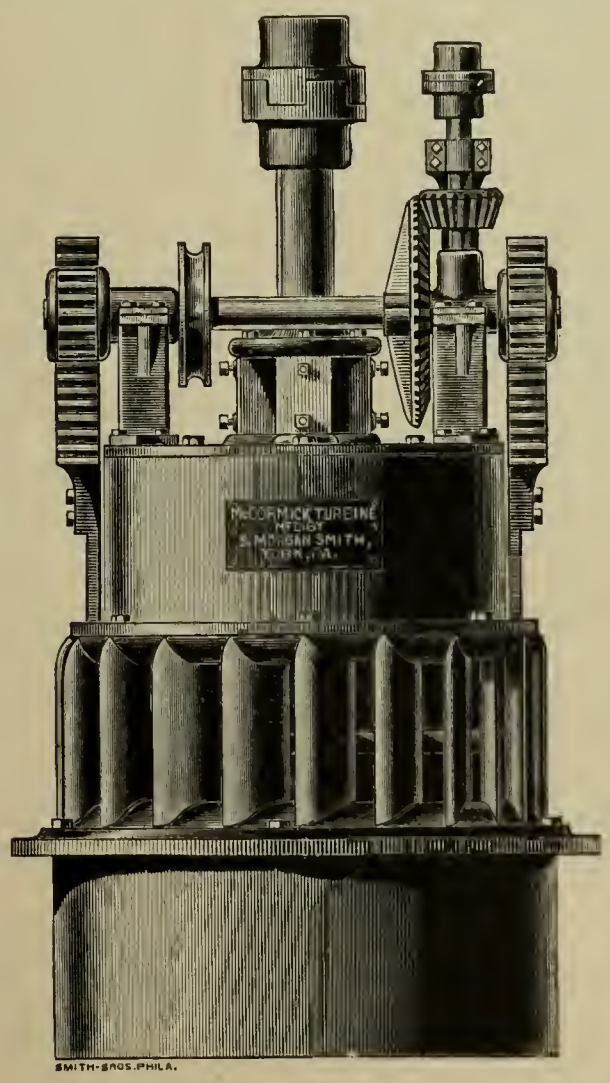
This engraving represents two pairs of horizontal 42-inch McCormick turbines, mounted in iron cases on horizontal shafts. They are coupled together, and the power is taken off at one end of the water wheel shaft, which extends into the mill, by three rope sheaves 10 feet in diameter, having 45 grooves for 1¾-in. ropes. There is also a 27-in. McCormick turbine on horizontal shaft, direct connected to a 1,000 gallon fire pump. This turbine also drives the dynamo. The combined power of these turbines is 2,355 horse. The water is supplied to the turbines by two pipes 10 feet in diameter, which are attached to the sides of the wheel cases. The entire outfit was built and erected by the company at the new No. 3 mill of the Clifton Manufacturing Co., Clifton, S.C.



This engraving represents one pair and one single 21-inch McCormick turbines, mounted on horizontal shafts in iron cases, operating under 64-ft. head, the ice manufacturing plant of Chas. T. Westcott, Baltimore, Md. By means of the Worrall friction clutch between the pairs and the single wheels, the latter can be disconnected from the former, when it becomes necessary, owing to lack of water, to operate but two wheels. A shaft about 60 feet long is connected with the shaft of the turbines and on the extreme end of it is a rope sheave, from which the power is transmitted to another rope sheave, located in the mill, about 200 feet distant. The water is supplied through a pipe about 125 feet long. The entire outfit was built and placed in position by this company.

that when informed as to what power is needed, and head of water available, they claim never to make a mistake in the size and number of water wheels required to operate the plant to the best advantage.

The McCormick wheel is the invention of John B. McCormick, who also invented the Hercules wheel and did much toward the designing of the Victor wheel. The McCormick is his latest invention, and embodies new points of merit in its construction. It is very heavy, strong, well-built and nicely finished. It is a cylinder gate wheel. The gate consists of a ring or cylinder, which is raised or lowered by means of the gate operating device, thus regulating the flow of water to the runner. The guides through which the water passes to the runner are stationary. The gate is balanced, thus making it operate very easily. Hundreds of these wheels are in operation throughout the world, driving all kinds of machinery. A great many have been sold in Canada. The following is a list of some people in Canada who are using McCormick wheels furnished by this company:—Sault Ste. Marie Pulp and



Paper Co,, Sault Ste. Marie, Ont., 18 vertical 51-inch; E. B. Eddy Co., Hull, Canada, 2 pairs of horizontal 42-inch; Riordon Paper Mills, several different sizes; the Montreal Cotton Co., Valleyfield, Quebec, 2 60-inch, together with gears and shafting, and a duplicate of this order now being built for the same company; Municipality of Valleyfield, Que., a 60-inch, together with gears, shafting, friction clutches, etc.; Milton Pulp Co., Milton, Nova Scotia, 4 33-inch; Morgan Falls Pulp Co., New Germany, N.S., 3 33-inch; Sissiboo Falls Pulp Co., Weymouth Bridge, N.S., 1 45-inch, 1 27-inch, and 2 33-inch; Farnham Electric Light Co, Farnham, Quebec, 42-inch; G. K. Nesbit, Cowansville, Que., a 27-inch, etc

A NEW USE FOR SCRAP MICA.*

BY C. H. MITCHELL, TORONTO

Mica is found in irregular crystals in almost endless varieties of size and color. It is one of the most perfectly foliated of all materials, the laminæ being so delicate in many specimens as to require the almost incredible number of 300,000 of them to form a thickness of one inch. Mica crystals are more or less seamed or cracked, so that often an apparently perfect crystal when split open parts and subdivides into a number of small fragments. This unfortunate characteristic has really been the cause of much of the disaster which seems so often to have dogged the steps of mica mining in this and other countries. It is bad enough to have to deal with any material which occurs in pockets which pinch out without warning, and which leave no particular indication or lead as to where it may be found again. If all the deposits of mica which have been found in Canada had produced crystals more or less free from cracks and flaws, most miners would have been content with their finds, and would not have been so much concerned as to whether or not it was a pocket or a true fissure vein. Then again many deposits of mica disclose a large portion of crystals twisted and destroyed to such a degree as to render their cleavage almost impossible. These together with the fragments already referred to, find their way to the dump, having thus far served no other purpose than to add very largely, and in some cases prohibitively, to the cost of mining the merchantable article. We shall, however, resurrect them presently, and I trust be able to demonstrate that instead of a loss, this hitherto costly waste may become a valuable by-product of mica mines. The proportion of waste or unmerchantable mica in every ton mined is very considerable. I do not know that the percentage of it to the ton has ever been approximated, but the evidence of a large number of miners would seem to indicate that it would average not far short of 70 per cent. of the total product. There are many instances I am aware where the average waste per ton is considerably less, but there are also as many cases where the percentage is as much higher, so that I think I am justified in venturing that estimate.

So far I have referred to mica in general, but now we must notice the particular groups of it in Canada. These we may determine chiefly by the variety and color of the material. There are, as I have said, almost innumerable variations of color and shade, from the nearly pure white to jet black, but for general purposes we may divide them into three groups—white, amber, and black. White mica appears to be very scarce in this country, as compared to the quantities of amber and black, and as it is almost perfectly transparent, it has always commanded a much higher price than the other varieties. I may say, too, in speaking of white mica, that there is a value for the waste or scrap of it, as when pulverized it has a beautiful lustrous appearance, which leads to its being utilized for wall-paper silvering and other decorative purposes. As, however, it does not appear to have been discovered in anything like the same quantity as amber and black in Canada, it has not as much interest to us as the commoner varieties. The great bulk of Canadian mica is included in all these shades of amber, silver, red and brown, which range from

* A paper read before the Ontario Mining Institute.

cloudy or milk white to dense black, which latter, as far as I know, has had no value whatever. I now come to this new use for waste mica; although we can use the refuse of nearly all these varieties, excepting badly twisted crystals, it is the soft amber and light brown micas which we prefer for our purpose. This is fortunate for all concerned, as it appears to be the most abundant. We find that by taking these scraps or waste pieces and subdividing them as finely as possible, and then quilting them between galvanized wire netting, that we produce a fireproof mat, flexible and clean, and a non-conductor of heat. It will be noticed that all these flakes are ribbed or corrugated, the object being to increase the number of dead air spaces in the mat, and also to add to its bulk without increasing its weight. The finer we are able to divide these flakes the more effective they become, as each one in itself is an effective non-conductor, so that the greater number we are able to get into a given space the higher the results are in checking the escape of the heat waves.

It will be seen that these mats, or quilts, are not only fireproof, but are flexible and elastic, which is a most valuable feature, as they will expand or contract with the iron they cover without cracking or flaking off. No doubt many of you have seen boilers covered with some of the old-fashioned cements, which being put on wet and allowed to set on the material, often crack and split to make room for the expansion of the material beneath. In time it will loosen and fall off, and requires constant patching to keep in order. The real value, however, in making these mats in sections, is that they can be removed whenever it is desirable to examine the shell of the boiler, and can be replaced easily and quickly without injury. As you will notice, they are secured to the boiler by means of hooks attached to iron bands, which are passed round the boiler under the mats. Besides this covering for boilers, the waste mica is made into sectional covering for all sizes of steam and hot water pipes, the only difference being that the mica is stitched between a wire core which fits the pipe, and an outer covering of canvas. The sections are secured to the pipe by lacing round the boot hooks, which are riveted up the seam at convenient distances. Covering for all sizes and shapes of fittings, including elbows, tees, crosses and globe valves, are also made and secured to the iron in the same way. These have been difficult to make, owing to the intractable character of the mica flakes themselves, as being very elastic, it was found hard to bend them to the various shapes. We found the same difficulty in making the flakes bend round the smaller sizes of pipe, but finally succeeded by separating them into different sizes in the same way as coal is graded, the larger flakes being used on the larger sizes, and so on down to the small half inch pipe. Perhaps I may be allowed to refer here to the not unnatural idea that using the mica in this loose dry form it would be liable to shift or sag in the wire netting or canvas case. This, however, is not the case, for the reason that the flakes being of irregular shape, with the rough edges and ribbed surfaces, they catch and bind one another, matting together as hair does. As a proof of this, we may say that after nearly two years in constant service on locomotives, where there is probably heavier and more constant vibration than is found anywhere else, the mats have been found in perfect condition, and in the opinion of railway engineers are likely to last an indefinite number of years.

How vast the market for this material is may be imagined, when I remind you that every locomotive in use the world over has to be protected with some substance; that every steamer that puts to sea has boilers which require hundreds of tons of coal to feed them (in one of the great battleships of Great Britain lately launched, there were no less than 48 boilers), and that every stationary steam plant has a boiler or a battery of boilers, which require covering to minimize the loss of steam and power by radiation. How great this loss is few manufacturers, or indeed engineers, seem to realize As you of course know, it is occasioned by the condensation of steam, that is, you allow the steam which you have generated often at great cost of fuel to cool off and condense by allowing the surface of the boiler and pipes to remain exposed to an atmosphere many degrees colder than they. With steam at 75 lbs. gauge pressure, it has been estimated that the loss of horse-power on different sized pipes uncovered is about as follows:—

2-inch	pipe	1	horse-power	lost	for every 132	feet long.
4	"	1	"	"	75	"
6	"	1	"	"	46	"
8	"	1	"	"	40	"
12	"	1	"	"	26	"

So that when you complain that you cannot get power out of your engines, or that the boiler seems too small for the job, you may solace yourselves with the thought that it is very often because you don't know enough to keep your steam dry. An argument often heard among mining men is that as many of them use wood for firing their boilers, it is not so much consequence if it does take a little more of it to keep up steam. Suppose that is true, it is difficult to believe that it is wiser to tie down the safety valve and pile in wood to carry steam through long runs of pipes than to remove the necessity of doing so.

Another use for this waste mica is for fire-proofing. Mica, like everything else, will fuse if there is heat enough, even "the elements will melt with fervent heat"; but it will stand an almost incandescent heat without injury, and for that reason it is a very valuable substance for fire-proofing. Considerable quantities of it have been already used for protecting smoke flues, kilns, etc., and in some factories the underwriters have reduced the premiums after the flues have been insulated with mica. In this connection, it is not without interest to refer to the fire risk in some mines from unprotected steam pipes. I have heard that a serious fire occurred in a mine lately in Canada, which was directly attributable to a live steam pipe which ran in close contact to a wooden sheeting or boxing, and which subsequently took fire. It is very questionable whether a fire could be started from steam heat alone, but it is perfectly certain that wood may become so charred and calcined from contact with a live steam pipe, that a drop of oil or grease falling on it would quickly cause combustion. So that here again we find a use for mica. I cannot refer in detail to all the other actual and possible fields and usefulness for this hitherto despised waste product of our mica mines, but I must not leave the subject without touching on its qualities for resisting the other extreme of heat, namely, frost. It is said extremes meet. They do in this instance, for the identical covering made for fire-proofing gives splendid results in frost-proofing, and I have no doubt at all that mica will shortly be used for insulating cold storage chambers. Being free from organic matter to mold or smell, it will not taint even such susceptible commodities as butter or milk, not the least valuable of its advantages.

As those interested in mines and mining, you will doubtless enquire what effect this discovery is likely to have on the mica industry in Canada? This altogether depends on the demand. If it increases as it is doing now (the sale of it advanced 98 per cent. last year), very large quantities indeed will be required. I believe that while this new industry may not justify mining solely for its requirements, yet every ton of waste or refuse used in it means so much less cost of mining, and so much more profit in the year's business. It should make a considerable difference to the expense of mining, if in the future it is known that by simply laying aside in some protected place the waste and scrap which has hitherto been consigned to the dump, a certain amount of revenue may be earned which will lessen the general expense of mining.

The building up of industries in Canada which use as their base raw material produced entirely in this country, must be of ultimate benefit to the general community, and I think we must all deplore the conditions which appear to result in so much of the raw material of this country being shipped out of it, to benefit the towns and villages in the countries in which it is manufactured. We must recognize the enterpise and pluck of foreigners who come to this country and develop our latent wealth, but we must also deplore the fact that it often results in the large profits of the enterprise being carried away and spent amongst other peoples. The profits of much of our Nova Scotia coal mining is not unappreciated in Boston; the great lumber mills of Michigan know something of the value of Canadian logs. The paper pulp mills of the United States are not indifferent to the wood-pulp of British America, and even distant Spokane has associated the gold mines of British Columbia with many a new brown stone front in that city.

GOLD QUARTZ MINING IN CANADA AND VICTORIA, AUSTRALIA.

BY F. HILLE, M.E., PORT ARTHUR, ONT.

Dr. A. R. C. Selwyn, in a paper read before the Canadian Mining Institute, published in full in the *Canadian Mining Review*, and in a synopsis of the same paper in THE CANADIAN ENGINEER, entitled "Gold Quartz Mining in Canada and Victoria, Australia," tries to give us a picture and comparison of the gold mining industry of both these countries, and comes after lengthy argument at last to the conclusion that they could not be compared with each other. "For the reason," he says, "Canada is essentially an agricultural and pastoral country, and it is very unlikely that it can vie in gold produce with the smallest province of Australia." Well, then, if this is the case, in the Doctor's opinion, why then make comparisons? He tells us he did it because "it is only by knowing and comparing with results elsewhere that we can gain a true and accurate knowledge of our own results and possibilities." This is cor-

rect when the fundamental conditions are equal, and we have a true and accurate knowledge of both subjects here—our resources and those of Victoria. But let us see if these conditions are equal.

Victoria's geology has long been known in detail, ours very far from being so as yet.

Victoria's economical geology is looked after by the different Government departments very attentively; ours was not till lately.

Victoria's climatic condition for all year outdoor work is better than ours.

And when we add to these considerations the Doctor's belief in the great difference in the geology and occurrence of economic minerals in both these countries, then surely any person must be at a loss to see the reason and utility of the Doctor's comparisons. But we learn further from his exposition that he wants to give us in these days of booms cold facts about our mineral resources, "to warn us of that most pernicious and meanest of lies—half the truth." This is undoubtedly very good to guard our material interest, but I question very much if he is able to give us cold facts, if he is possessed of a true and accurate knowledge of our possibilities. Why? Because he visited only a very small part of our districts, and his former staff had no orders from him "to waste time in economic geology." What do we know through the Geological Department, and especially under the guidance of Dr. Selwyn, about Western Algoma in regard to ore deposits, or their genetic relation to our rocks? Nothing! Yes, even the report on that part east of Rainy Lake to Sudbury is not yet published. And the Doctor tells us that he can give us true but cold facts! It is indeed to be lamented that he, although for many years director of the Geological Survey, has kept back this country through an inexcusable prejudice, which originated in his belief in his infallible gift of prognostication. Instead of concentrating the forces of the geological staff, and surveying those districts which were more populated and of easier access, and laying more weight on economic geology, he sent the gentlemen of his staff to the inaccessible, uninhabited and uninhabitable regions to the north. Of course to whose benefit could it be to know and learn the names of those barren rocks in the western part of Ontario, and barren they are, so he believes. And he must be correct, because he informs us he had also foretold the great possibilities of the Victorian gold fields, and further also those of the Nova Scotian, because the rock formations were identical with the Victorian. This prognostication reminds me of the effort of Sir R Murchison, who predicted in 1844 the gold occurrence in Australia, because certain rocks from that country showed similarity with some in the Ural Mountains.

Everyone who has an idea of the formation of veins knows that gold, or other deposits, are of "local" occurrence. We find similar or even identical geological conditions in many parts of the world, but do we find now in every instance ore deposits of the same character in these rocks? No, not by any means. This brings to my memory a similar incident which I observed last year. I had a gentleman of our fraternity from one of the south-western States with me in one of our western districts for the examination of some gold properties. His first question was whether we had porphyries in this country. The reason of his asking was very easily discovered, when I considered the occurrence of gold in his country being in the porphyry. But now let us see if the Doctor had not been equally justified in comparing the geology and ore deposits of our Western Ontario districts with the Victorian, as he did with the Nova Scotian. If he had examined our rocks somewhat more closely he would have found them to be very similar to the Victorian, if not in many instances identical with them. The latter deposits occur, as it is in most instances here, in the metamorphic rocks in the neighborhood of intrusive granites. Now, why not be consistent, and give us the same benefit of his prognostication as Nova Scotia, if he is so well versed with our geology? The Doctor said among other things: "It seems unlikely that the history of gold mining in Canada will differ from what it has been in other countries and under corresponding geological conditions." Well then Canada must have a good future, and could be well compared with Victoria, according to Dr. Selwyn's theory, because the geological conditions correspond very well. Again he says: "What the effect of the opening of new ground, better mechanical and chemical methods and appliances may be, we have yet to learn, but it is not likely that in the next thirty years an equal amount of gold produce will ever be recorded." There we have again the prognosticator. How does he know that there will not be more and more extensive gold placer and quartz mining ground found? Already we hear of new placer regions, and extensive trials are going on to win the fine gold in the Saskatchewan and other rivers. From season to season we extend by prospecting the gold bearing areas. Those in Victoria cannot be compared in extent with ours in Ontario, not to speak of the Western Provinces, and I have no doubt that by sufficient influx of money and a little more enterprise on the part of our people, we shall succeed in the same way as Victoria. Yes, we would be so far now if the former director of the Geological Survey had shown the same interest for our mineral industry as the Victorian authorities have done and still do, by sending qualified mining engineers into the different mining camps for exhaustive information in regard to the genetic relation of the ore deposits to the various rocks. These informations and reports contain valuable advices in mining and milling operations. If we had initiated this wise practice, our industrial conditions would look quite different to-day.

Not even the reports are published, with the exception of the Seine River and Shebandowan sheet, for whose early issue we have to thank Dr Dawson, and neither are the maps of West Algoma published yet. Now can anybody tell me what good they will do to the development of our districts and provinces, when they are published two and even three years after the surveys are made? And when they are available to the public, of what benefit are they to the prospector? Do they tell or point out to him where and in what formation he can find the different economic minerals and metals, and in what relations they stand to the different rocks? Economic geology should go hand in hand with stratigraphical or structural geology; only then is the latter of practical value. If Dr. Selwyn had done more in this regard in our western districts he would have now a better knowledge of them, and would have perhaps reconsidered the passage in his paper that Canada "was essentially an agricultural and pastoral country." The Doctor forgets that the times of the old miners are past; as dynamite has superseded black powder and the fire setting methods, so has the air drill taken the place of the tedious hand-drill. Mankind is too busy, and time is too valuable—we want to see results as quickly as money can bring them about. We cannot wait for the old miner any longer, "till he is done with his tunnel in a hill-side." For this the "new miner" needs money, and to procure it he has to follow the custom of the times, to show what he has to sell, and the more truly and openly he does it the better for him and his customers.

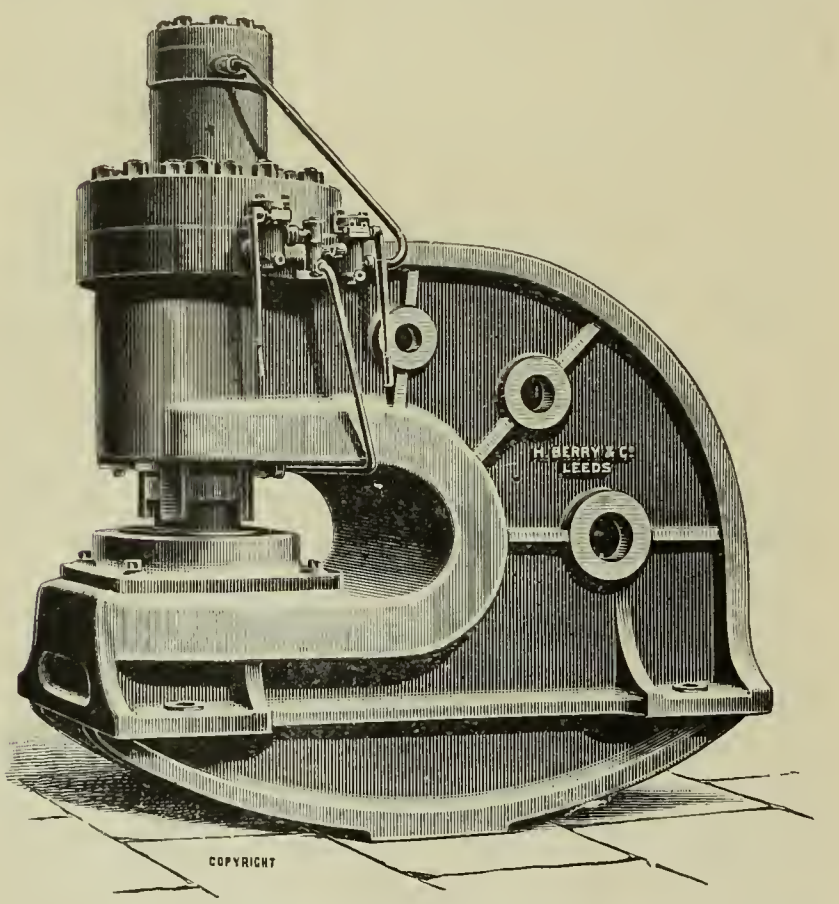
Dr. Selwyn compares the production of gold in Canada, and especially of British Columbia, with that of Victoria. How far he is justified in doing so we shall see. The earliest production of gold in British Columbia came principally from placer workings, very little from quartz mining, as in the case of Victoria. In the year 1858 it produced 40,275 ounces, and increased rapidly to 1863 up to 223,632 ounces, but fell then the more the Fraser River and other diggings were worked out, very gradually down to the year 1894 to 21,275 ounces. But since quartz mining operations commenced there more systematically and energetically the production increased in the year 1895 nearly 300 per cent., that is to 62,436 ounces. Now I have not the slightest doubt that we shall see in the next few years the production climb up to that of 1863, if we consider that there are daily more mines opened up, and as I mentioned above, new and more extensive placer ground to be discovered, and we may yet see the production of gold in our North-West reach that of Victoria. Now, if we look at the Doctor's list of Victoria's gold production, we observe here exactly the same falling off as we have seen in the British Columbian. The largest amount was mined in the second quinquennial period; so it was in our Province, and decreased then to the year 1891, when most of the placer mines were worked out, and would have kept on decreasing if the cyanide process had not enabled them to work their old dumps over. Victoria has undoubtedly reached the height of its gold production, while British Columbia is only beginning now with gold quartz mining, and also with new placer ground. The same can be said of Ontario. Very little is known of its vast areas of gold-bearing rocks; but what is known justifies us in saying that it has as good a future as Victoria had 40 years ago as a gold-producing country. Dr. Selwyn exemplifies a few old prospects worked in the beginning of the seventies, in the Lake of the Woods district, and belittles these mining ventures; at the same time he tells us that they were examined by a gentleman of the geological staff, and creates the impression as if Mr. Coste's report had been unfavorable. Exactly the contrary is true. He commented unfavorably on the different companies' method of working, but had no fault to find with the veins. A number of the latter are undoubtedly good true veins. The principal reason for discontinuing the work on these mines was the same that has characterized also the later mining periods of the Lake of the Woods: Insufficient capital, lack of knowledge of mining and of geology, complete ignorance of metallurgy, and employing of inefficient milling machines, and this latter is up to date

the case. Since more capital has flown into that country, and more systematic mining practiced, the Lake of the Woods is showing up very well indeed. On superficial examination, the geology of that country seems complex, but by repeated visits and closer study a person can read more intelligently those ancient hieroglyphics of nature. The same can be said of many other places in our Western Ontario districts that are rich in different minerals, which should have been known long since, if the former director of the Geological Survey had sent his staff there ten or twenty years earlier.

In summing up what I have said about the part that Dr. Selwyn has played in the development of our Western country, and the information he has gathered in regard to our ore deposits, I must deny him the right to speak publicly and authoritatively on the possibilities of this country.

HYDRAULIC MANHOLE PUNCH.

The accompanying engraving shows a powerful hydraulic manhole punching machine, capable of punching at a single operation a manhole 27 x 22 inches, out of a piece of metal three-quarters of an inch thick. This machine is one of the numerous special tools



HYDRAULIC MANHOLE PUNCH.

made by Henry Berry & Co., the well known manufacturers of hydraulic machine tools, of the Croydon Works, Hunslet, Leeds, England This machine is invaluable in ship yards, boiler shops and similar establishments, and is made in several sizes.

THE NEW CROCKER TURBINE.

It is manifest that the evolution of the turbine is keeping pace with advance in other lines of mechanical art. A decade ago, iron wheels were frail in construction, of small capacity, and uncertain in results. A glance at any old water-wheel catalogue will reveal the progress. A 30-inch runner was tabled to develop say, 50-h.p. under 20 foot head; the modern turbine gives nearly three times this power, and the efficiency has been raised from 15 to 20 per cent. also. These important results have been realized by men of natural talent, aided by practical experience gained by close observance of the results attained by the various types of wheels in use. It is a curious feature that no turbine of purely mathematical or scientific origin has held a place on the market. The horizontal system of installing turbine plants is highly successful. Under more than moderate falls, this is said to be the most desirable plan. The removable step-socket now used with vertical wheels has, however, greatly lessened the difficulties experienced heretofore with that mode of setting. The turbine style furnished the most economical power and the greatest percentage of the force expended. With it, electrical energy can be generated at the lowest possible cost. Thus, every water privilege having reasonable constancy, is destined to become valuable and available for the development of local or distant enterprise.

The subject of this article, the Crocker Turbine, is claimed to embody all the desirable characteristics required in the diversified industries of to-day. The runner, or wheel proper, is a model of design and scientific construction. It unites ample strength in a union capacity, and the highest efficiency obtainable. The gates and chutes are so formed and secured to the casing as to be easily operated, even under high heads, which admits of perfect regulation by ordinary governor. The surface formed by gates and chutes introduce the water to the wheel in solid streams, the full height of bucket, thus producing high part gate results and uniform speeds under variable conditions. Every particle of water is directed on to the buckets; there is no leakage through the crown plate to the wheel vents, which is always said to occur when cylinder gates are used. These turbines are manufactured by the Jenckes Machine Co., Sherbrooke, Que.

ESTIMATES BROUGHT DOWN BY THE DOMINION GOVERNMENT.

RAILWAYS.		
Intercolonial Railway—		
Increased accommodation at Halifax	$135,000	
Extension to Halifax cotton factory	40,000	
Other equipment	173,000	
		$348,000
Prince Edward Island Railway—		
Improvements		19,000
CANALS.		
Soulanges—Construction		1,250,000
Cornwall—Enlargement		185,000
do Converting basin into dry dock		15,000
Farran's Point—Enlargement		375,000
Rapide Flat do		115,000
Galops do		1,635,000
North Channel - Straightening and deepening		375,000
Galops Channel do do		50,000
River reaches		50,000
Lake St. Francis—Removal of boulders, etc.		75,000
Trent—Construction		650,000
Sault Ste. Marie—Construction and equipment		75,000
Lachine—Enlargement		216,000
do Deepening river at St. Pierre		40,000
Lake St. Louis Channel—Straightening and deepening		86,000
Grenville—Enlargement		90,000
To pay George Goodwin final estimate and award of Walter Shanly		45,696
Chambly—		
To complete drainage works and culverts at St. John's, Que		25,000
Rideau—		
New Swing Bridge, Ottawa		10,500
Welland—		
Pier at Port Dalhousie		20,000
Fender works for new bridges		18,500
St. Lawrence Ship Canal—		
Improvements		200,000
River Kaministiquia, Ont.—		
Improvements		18,000
HARBORS.		
Nova Scotia—		
Various wharves and breakwaters		55,100
Prince Edward Island—		
Piers, wharves, etc.		73 800
New Brunswick—		
Wharves, dredging		33,500
Quebec—		
Piers, breakwaters, wharves, dredging		73,800
Ontario—		
Wharves, dredging, piers		306,000
Manitoba—		
Wharves, etc.		11,500
North-West Terrritories—		
River and bridge works		5,000
British Columbia—		
Dredging, wharves		49,250
PUBLIC BUILDINGS.		
Nova Scotia—		
Halifax drill hall		110,000
Ontario—		
Arnprior post office		15,000
Manitoba—		
Portage la Prairie post office		20,000
British Columbia—		
Victoria post office		53,000

THE MINES OF ONTARIO.*

BY J. F. WHITSON, O.L.S.

I will endeavor to give some of the information I gathered during the two years I was an active explorer in the Rainy River, 1890-91, and from what I have gathered during the last few years, when I have been somewhat closely connected with the mining interests of that district, so that you may have some idea of the great mineral wealth of Ontario's most westerly possession. I am fully alive to the responsibility resting on anyone writing about a new mining country, and shall hew closely to the line, so that no one going to the new field shall be disappointed in not finding things fully as good as stated in this paper, but rather be able to say the half has not been told.

Indeed, it would be very difficult to overestimate the possibilities regarding the mineral wealth of New Ontario. Up to the year 1856, when Napier made his first exploration trip through the district, but little was known of the new region, and, in fact, that statement would almost hold good at the present time with reference to a great portion of the country lying even south of the C.P.R., between it and the northern boundary of Minnesota, while the country to the north of the railway is as yet a closed book. The building of the great railway, the C.P.R., has done much to open up the western country, and no portion of Ontario has been more benefited than has this new district. It occupies that great stretch of country lying between Thunder Bay district and the Province of Manitoba, 192 miles in width, and extending from the northern boundary of Minnesota, north to Lake Seul, 175 miles in length, on its eastern boundary, and averaging not less than 125 miles, and comprising an area of nearly 20,000 square miles, or about 12,000,000 acres, including within its limits the Lake of the Woods, with its 1,400 or more islands; Rainy Lake, with its 600 miles of coast line, or more than that of Lake Ontario, Manitou, Wabigoon, Eagle, Lonely, and more than a thousand other lakes, in fact, one might call it "the land of a thousand lakes."

The general physical characteristics of the country are very similar to those found in other glacier-swept Archean tracts, such as the north shore of Lake Huron, Muskoka, or Parry Sound. In few places is the country as mountainous as the north shore of Lake Superior, or as difficult to explore as the region north of Lake Huron. Within the district are to be found many large and magnificent streams—Rainy River, 80 miles in length, with an average width of not less than 500 feet; Winnipeg, English, Seine, Manitou, Eagle, and many more streams are quite navigable for large boats in places. The geological formation of the district is either Laurentian, Huronian or Keewatin, and post glacier, the Laurentian rocks predominating. The most recent, the clays and sands, form the agricultural section of the region along the Rainy River and around Wabigoon.

Of the total area of the district, nearly 5,000 square miles is covered with the Huronian, or gold-bearing, rocks. It will, therefore, be seen what a vast field there is for prospectors in this new district. I believe that this new Ontario will yet be one of the richest gold districts in the Dominion within the next ten years; yes, on the continent. The success which has attended mining in that thinly-populated and undeveloped condition of the country in the past two years is but an evidence of the great success which awaits the future exploration, not only for gold, but for other minerals.

The history of the district since attention was first drawn to it by the discovery of gold, about fourteen years ago, shows that nearly all the exploration to which the country has been subjected, up to within the last 18 months, has been confined to the shores of the Lake of the Woods, Rainy Lake and a few of the larger streams tributary thereto. Few prospectors have ever penetrated into the interior; in fact, this will apply even up to the present time, they having contented themselves in prospecting the main waterways, which are easy of access, going back but a short distance inland, so that at the present time but a very small portion of the country, even convenient to the C.P.R., or the larger lakes, has as yet been even partially explored.

Long after the first discovery of gold on the Lake of the Woods, very little development work was done, except on the Pine Portage and Sultana mines; this was partly owing to the want of capital, but more particularly to the belief that there was little gold to be found in the district. The good results attending the development of the Sultana mine have done much to encourage others to prospect and develop discoveries, and in nearly every instance where development work has been done the results have been highly satisfactory, so much so that during the last two years prospecting has been very active, and has resulted in the discovery of a great many veins of gold-bearing quartz, many of them undoubtedly rich and will yield large profits when mined.

Mining, properly speaking, can scarcely be said to have more than begun, except in a few cases. Prospecting, however, has been very active, and many of the leads are well stripped and opened into. No less than 100 different mines are being developed or partly so, so that with the increased shipping facilities, the building of new roads by the Government, the investment of English and foreign capital in the district of late, it is confidently anticipated that this year will see extensive mining operations and good returns therefrom, in fact, there are no less than half a dozen stamp mills, either being shipped into the district or being erected at the present time.

The good results of the last six months mining have given to those interested in the future of the Lake of the Woods unqualified satisfaction. Everything, with few exceptions, has gone to show that their confidence has been well grounded. Those who were at first most skeptical as to the permanency in depth and richness of the deposits have candidly yielded in the face of the unquestionable evidence offered them in the splendid showing of such mines as the Sultana, at a depth of 400 feet, with an enormous body of rich ore at that depth, and every appearance of an unlimited quantity, which can be mined and stamped with even a 10-stamp mill at less than $4 per ton. The Regina mine, at a depth of 256 feet, with a similar mill, is producing gold at nearly the same cost per ton, other mines in the district, such as the Mikado, Yum-Yum, Cornucopia, Gold-coin on Shoal Lake, Gold Hill, Black Jack, Princess, Scramble, Trojan, Triumph, Bath Island, and many others on the Lake of the Woods, are producing large quantities of rich ore, and there is scarcely the shadow of a doubt but that most of them will be pay mines. The Mikado yielded 136 tons of ore at first clean up, while the Saw Bill, Lake Harold, Hawk Bay, Folger and Hammond are all producing large quantities of ore, and are undoubtedly splendid mines. On Seine River the Foley mine has a 20-stamp mill at work, and can work the ore at $3 per ton. They are down several hundred feet in the shaft, and there is every appearance of it being a permanent mine. The Porcupine, the Weigand, Proudfoot, and many other mines on the Seine River, are turning out very successfully.

Rainy River, as a gold district, can be conveniently divided into five sections—first, and probably the most important, is the Lake of the Woods section, including all the country northwest of Rainy Lake and around Shoal Lake; west of the Lake of the Woods, comprising an area of not less than 2,000 square miles, in which there has been over 1,500 claims surveyed, and the Rainy Lake section. Gold was first discovered on a small island in Rainy Lake on the Minnesota side of the line, in the fall of 1893. In the spring of 1891 was found a small nugget of free gold on Hunter's Island. Since that time the prospecting has been very active and several good mines located, on which stamp mills are now working. The Manitou section, comprising the country round Manitou, and Wabigoon and Eagle Lakes, in which there are over 300 locations surveyed and several good veins, well developed, and from all appearance this has every likelihood of being a very good gold district. One of my Indians, in 1890, found a sample, showing free gold, at the head of this lake, and I arranged with him to take me to the place, but a few hours before starting the Indian got drunk, and I have never been able to get him sober enough to go out.

The Saw Bill Lake section, including the country around Saw Bill and Harold Lakes, in which about 125 claims have been surveyed; this is one of the most promising sections in the district and contains the great Folger and Hammond dyke from 10 to 300 feet in width and nearly a mile in length, and which appears to assay from a few dollars per ton up to $100 or more; this is probably one of the largest quartz ledges ever discovered in the province, and is probably one of the most enticing properties on the market.

The year 1883 marks the beginning of surveys of mining locations on the Lake-of-the-Woods. No less than 4,000 claims have since been surveyed, during the last two years 2,500, and over 1,500 during the last 12 months. Within the district 1,500 patents and mining leases have been issued, covering over 2,000 claims. From fifteen to twenty Ontario land surveyors and their assistants are in the field at the present time, hard at work. Of the 4,000 claims already staked out there are, of course, an unusually large number of worthless and comparatively worthless properties, but at the same time there appear to be an unusually large number of promising veins. If one claim in every 100 proves a paying mine, forty gold mines in the district mean a great deal. If 2 per cent. prove successful properties, it will make one of the best gold regions in the Dominion, if 5 per cent. it will surpass that of California. A

* A paper read before the Association of Ontario Land Surveyors.

purchase, carefully and judiciously made, may be safely calculated upon as likely to yield, under proper and economical management, profits that will compare very favorably with some of the best known gold districts. It is not improbable that even a few very rich claims will be found, but the legitimate claims of the region are based upon the free-milling character of the ore, the large quantities of ore in sight, the true fissure veins, the economy with which the ore can be worked, owing to the abundance of fuel, the splendid shipping facilities afforded by the navigable streams and lakes, and the abundance of good water-power.

One great drawback, however, to the mining development of Western Ontario is the fact that so many of Ontario's investors are land speculators, rather than mining developers. They are willing to lease or purchase large tracts of mining land at $1 or $2 per acre, with the hope of selling it at a fabulous price, without spending one single dollar in development work, and thus the barter and sale of mining lands go on. Many of the small investors in the poorer claims will never reap a dollar in return, and there are hundreds of worthless claims in this district. I fear that in the course of only a few years, at the mouth of the shaft of many of these partly developed claims could be erected a slab, and on it the inscription written, "Died for want of sufficient capital to develop."

This new district is a province within itself with a future, possessed as it is of great natural advantages as a mining country, and peop'ed with an industrious race, her progress cannot be checked, as her resources are becoming better known, her towns and villages are becoming more populous, while sturdy farmers from the East are filling her agricultural areas, and on every hand can be seen abundant evidence of prosperity and advancement.

THE VALEDICTORIAN AT McGILL.

G. R. MCLEOD.

G. R. McLeod, the valedictorian, said among other good things that they should be pleased that in their day a common interest actuated all the faculties, and made the success of class day and such like university undertakings a great success. One and all were coming to understand the unity of learning, a principle so ably upheld by the Principal and professors. Mr. McLeod then turned to his own faculty, that of Applied Science. During the four years the number of professors had been doubled, and the laboratories enlarged and filled with costly instruments. This was due to McGill's great benefactor, who will ever live in the memories of the Science men. With reference to the appointment of professors, Mr. McLeod continued, while not disregarding for a moment the ability of professors from other lands, yet he thought McGill graduates should be given a chance. Already those who had been appointed had filled their positions with distinction and success, and there ought to be more of them. At a time such as this there was a feeling of regret at saying farewell to University life. While a student was enriching his mind at the shrine of knowledge, he was not lessening the store, but adding to it. In this it differs from other pursuits, and in this lies its great chance. Mr. McLeod closed with a few well chosen words of farewell to the Dean and professors, speaking also of the regrets felt by all the class in breaking, for the time, at least, friendship which had sprung up during the year, and which had been of so much help in the student life.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain to Canada for March, 1896 and 1897, and the three months ending March, 1896 and 1897 :

	Month of March,		Three months ending March,	
	1896.	1897.	1896.	1897.
Hardware and cutlery	£6,228	£4,955	£16,322	£12,018
Iron, etc.—				
Pig iron.....	748	20	3,781	455
Bar, etc.....	645	830	3,067	3,031
Railroad	1,111	3,295	1,963	3,847
Hoops, sheets, etc.....	877	2,700	3,249	6,311
Galvanized sheets	1,312	2,615	5,333	5,841
Tin plates	8,165	23,141	31,134	61,542
Cast, wrought, etc., iron ..	3,642	2,252	9,566	7,004
Old (for re-manufacture) ..	....	96	....	572
Steel	5,469	5,302	17,554	10,235
Lead	702	791	2,870	2,070
Tin, unwrought	1,584	947	3,671	5,444

NEW ACETYLENE GAS LAMP.

A representative of THE CANADIAN ENGINEER has had an opportunity of inspecting a portable acetylene gas lamp, manufactured by the R. Mitchell Co., of Montreal, and invented by Dr. Casgrain, Quebec. It is now generally known that acetylene gas is produced by bringing calcium carbide in contact with water, and that this gas yields a light far more brilliant than that from coal gas and so pure that it is now used for photographic purposes. The upper part of the lamp contains a receptacle for water which is filled in the same way as an ordinary oil lamp. This is inserted into the cylinder containing the carbide, and the whole apparatus into a metal case, which may be plain or highly artistic, according to purse and taste. The water is allowed to run slowly from its receptacle on to the carbide, and the gas, which is instantly generated, begins to rise through an ordinary gas nipple. The quantity of gas generated is regulated by the stream of water and the water by a cock exactly as in a gas burner. The lamp is constructed on a plan which renders anything like explosion impossible, and produces an unmistakable warning when the gas is generated too fast. Water is easily enough obtainable and the carbide can be obtained at the rate of $80 per ton. One pound of the carbide is enough to prodnce an exceedingly brilliant light for 6 or 8 hours, at a cost of 1 cent per hour.

MINERAL PRODUCTION OF BRITISH COLUMBIA.*

AMOUNT AND VALUE OF MATERIALS PRODUCED 1895 AND 1896.

Customary Measures.	1895 Quantity.	1895 Value.	1896 Quantity.	1896 Value.
Gold, Placer....Oz.	24,084	$481,683	27,201	$544,026
" Quartz ...Oz.	39,264	785,271	62,259	1,244,180
Silver.....Oz.	1,496,522	977,229	3,135,343	2,100,689
Copper .....Lbs.	952,840	47,642	3,818,556	190,926
Lead .....Lbs.	16,475 464	532,255	24,199,977	721,384
Coal .....Tons	939,654	2,818,962	846,235	2,327,145
Coke .....Tons	452	2,260	615	3,075
Other materials.....	.....	10,000	.....	15,000
		$5,655,302		$7,146,425

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the meeting held on the 8th ult., Henry Irwin read a paper on the "Fraser Valley Reclamation," by R. E. Palmer, A.M., Can. Soc. C.E., the discussion upon which was postponed to next meeting. At the meeting held on the 22nd, under the presidency of P. A. Peterson, some members wished to discuss the paper read at the previous meeting on the "Fraser Valley Reclamation," but it was thought advisable to defer this until word could be received from the author. The discussion on Mr. Atkinson's paper on "A New Method for Dressing Car Wheels, Axles," etc., was then opened. A letter on the subject from Herbert Wallis was read by Secretary McLeod. He had tested wheels, both old and new, by the process referred to, and the experiments did not seem to warrant a change of methods. He expressed himself as quite in accord with the opinions of the author. Prof. Nicholson said he had seen a similar device at the Dominion Bridge Company's works, and wished to ask Mr. Atkinson how does the co-efficient of friction vary with speed? The co-efficient of friction diminishes so much at high speed that it pays to increase heat by electricity. What makes the grinding of chilled wheels harder than the chilling does? What is Mr. Atkinson's theory of what happens? Mr. Atkinson, in reply both to the letter previously read and to Prof. Nicholson, said that Mr. Wallace had taken for his experiments what are considered as condemned wheels. No wheel remains perfect long after being put into use. The cost of hauling a train is largely increased by the imperfections of wheels. Wheels could be dressed by the new process at a cost of 25 cents each. With regard to the question of abrasion, it is due to the friction of surfaces. The working disc will be more abraded at a lower speed than at a high one. He did not see how temperature could enter into the question. The particles from steel wheels are red hot. Not so with cast iron. The temperature in the latter case cannot be more than 70° to 80°, and that of steel-tired wheels is so little more that they can be handled, and, therefore, cannot be much higher than blood-heat. Heat is applied only to soften the surface of steel wheels and so reduce the horse-power required to turn them.

The President, P. A. Peterson, said that when the machine was first brought to Canada he took great interest in its working. It was at first badly put up, but its merits were even then evident.

* From the official report of the B.C. Minister of Mines.

It often happens that a day and a half is consumed in dressing a wheel by present methods, while this process would take about three quarters of an hour. At the Erith works in England, they could dress twenty wheels at day, at a cost of 5½d each. At the close of this very interesting discussion it was announced that the American Society of Civil Engineers intended to hold a three days' convention at Quebec, beginning on June 30th, and Messrs Hunt and Owen, members of the committee, who have recently passed through the city, intimated their intention of formally inviting the Canadian Society to join them.

THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The tenth annual banquet of the Hamilton C.A.S.E. was held in the Commercial Hotel, April 22nd. The chairman, R. Mackie, filled the chair in his usual happy manner. The following were visitors: Aldermen Findlay, Donald, McLeod; George Black, G.N.W. Telegraph Co.; W. H. Ballard, Inspector of Public Schools, and others. The toast list was as follows: "The Queen"; chorus, "God save the Queen." "Governor-General"; the "Maple Leaf" in chorus, W. S. Hyslop singing the solo. "Dominion Parliament and Local Legislature"; song, M. Wilson; response, James McLauchlin; song, W. S. Hyslop. "Our Army and Navy"; duet, W. S. Hyslop and M. Wilson; response, Thomas Carter. "The Mayor and Corporation"; song, W. Woods; response, Ald. Findlay, Donald and McLeod. "The Executive Head"; response, A. M. Wickens, Toronto; W. Blackgrove Toronto; R. C. Pettigrew. "Our Manufacturers;" response by A. Rodgers; song, Rod-Harris. "Our Sister Associations"; response by Walter Fox, Toronto, and J. Geary, Guelph. "The Learned Professions"; responses by George Black, Mr. Ball and Mr. Gill; song, M. Wilson. "The Press"; response by J. H. Mattice, of the *Globe*. "The Ladies"; response by J. N. Morris; song, by W. S. Hyslop. "Host and Hostess"; response by Mr. Maxey. The committee in charge of the affair was composed of R. Mackie, chairman; J. Ironside, secretary; W. Norris, W. Stevens, J. Johnson, W. Cornish. Mr. T. Bain had charge of the music and played the accompaniments.

Association Canadienne de Secours Mutuels des Ingenieurs-Mecaniciens P. of Q. have taken possession of their new hall, 392 Lagauchetiere St., Montreal. A report of the annual meeting will be given in next issue.

CANADIAN ELECTRICAL ASSOCIATION.

The following is the programme for the convention which opens at Niagara Falls, June 2nd:

LIST OF PAPERS.

"The Best Method of Increasing the Day Load in Central Stations'—J. A. Kammerer, Toronto. "Submarine Cables—Dealing more especially with the Actual Experience in Cable-Laying and Maintenance in this Country"—D. H. Keeley, Ottawa. "Determination of the Heating Power and Steam Producing Value of Coal from a Preliminary Examination"—Wm. Thompson, Montreal. "Water-Driven Plants"—John Murphy, Ottawa. "The Commercial Aspect of Electric Railways"—C. E. A. Carr, London, Ont. "Accumulators: Their Application to Central Station Lighting and Power"—W. A. Johnson, Toronto. "Why Some Lighting Plants do not Pay"—F. C. Armstrong, Toronto. "Steam End of an Electric Plant"—A. M. Wickens, Toronto.

It is proposed to introduce at this convention a question drawer, and members are invited to forward questions to the secretary prior to May 22nd, and an effort will be made to furnish satisfactory answers at the convention.

SOCIAL FEATURES.

Wednesday, June 2nd.—7.00 p.m.—By special invitation of the management of the Buffalo and Niagara Falls Electric R'y Co., an excursion by special electric cars from Niagara Falls, N.Y., to Buffalo. Visit of inspection to Buffalo Railway Power House. Returning, reach Niagara Falls about 11 p.m. By courtesy of the Suspension Bridge Co., members taking part in this excursion will be permitted to cross the Suspension Bridge in both directions without charge.

Thursday, June 3rd.—8.00 p.m.—Annual banquet at Dufferin Cafe.

Friday, June 4th.—By courtesy of the undermentioned companies, the following programme has been arranged:—9.00 a.m.—Special car will leave Hotel Lafayette for a trip over the Niagara Falls Park and River Railway to Queenston. 9.45 a.m.—Cross Niagara River by Niagara Navigation Company's steamer to Lewiston, N.Y. 10.00 a.m.—Leave Lewiston by special cars on the celebrated Gorge Electric Railway, reaching Niagara Falls at 10.45. 11.00 a.m.—Visit of inspection to Hydraulic Power House. 11.30 a.m.—Descend by Incline Railway and take steamer "Maid of the Mist" for a trip to the foot of the Cataract, landing on Canadian side. 1.30 p.m.—Cross Suspension Bridge. 2.00 p.m.—Inspection of the Power House and Works of the Cataract Construction Co. 3.00 p.m.—Visits to various Electro-Chemical Works.

THE TARIFF.

The tariff presents many difficulties, even at a cursory glance, both as to the immediate effect of its various clauses and as to the ultimate incidence of the taxation which it imposes. The whole subject is further complicated by the preferential clause, whose effects are as uncertain as at the moment its enforcement seems problematical. Whatever may be thought of freer trade with England, and most Canadians heartily endorse it, there can be little doubt of the wisdom of Protection against the United States. The Canadian tariff has been low, that of the United States high; when United States producers suffered from over-production they sacrificed their products in Canada; when the Canadian market was glutted our manufacturers had no such resource, but were compelled to dispose of their goods in competition with each other.

The abolition of the duty on machinery to be used in mining will, if not reconsidered, be a most serious injustice to a considerable number of manufacturers, many of whom have recently embarked additional capital in this department of industry. The admission of such machinery duty free means that virtually the whole trade will be done by United States manufacturers, and the prices current in the United States will rule in Canada. If a moderate duty be imposed, the Canadian maker would be enabled to remain in business, but in order to enter our market the United States manufacturer would have to reduce his price by the amount of that duty, and the prices to Canadian consumers would be practically the same as if they were supplied from the other side of the line, while all the advantages attending the development of this industry would be ours.

ROPE DRIVING.*

The subjoined table will be found of great value to those interested in the subject of rope transmission:

Diam. rope inches.	SPEED OF THE ROPE IN FEET PER MINUTE.									Smallest diam. pulleys inches.
	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	6,000	7,000	
¾	3.3	4.3	5.2	5.8	6.7	7.2	7.7	7.7	7.1	4.9	30
⅞	4.5	5.9	7.0	8.2	9.1	9.8	10.8	10.8	9.3	6.9	36
1.	5.8	7.7	9.2	10.7	11.9	12.8	13.6	13.7	12.5	8.5	42
1¼	9.2	12.1	14.3	16.8	18.6	20.0	21.2	21.4	19.5	13.5	54
1½	13.1	17.4	20.7	23.1	26.8	28.8	30.6	30.8	28.2	19.8	60
1¾	18.0	23.7	28.2	32.8	36.4	39.2	41.5	41.8	37.4	27.6	72
2	23.1	30.8	36.8	42.8	47.6	51.2	54.4	54.8	50.0	35.2	84

FIRES OF THE MONTH.

April 3rd.—A. Robson's elevator, Ayr, Ont. Loss, $4,500.——April 3rd.—McKinnon Sash and Hardware Co.'s factory, St. Catharines, Ont. Japan room damaged, $11,000.——April 6th.—Portland Packing Co.'s lobster factory, Canso, N.S. April 6th.—Jacques' saw mill, Hagersville, Ont.——Apr. 8.—Globe flour mills, Cornwall, Ont. Loss, $20,000.——April 10th.—Saw and grist mills, Verner, Ont., belonging to Father Paradis.——April 17th.—The Rathbon Co.'s shingle dock at Deseronto, Ont.——April 22nd.—G. A. Burrows' carpet factory, Guelph, Ont. Loss, $4,500. April 22nd.—Norsworthy & Lindop's machine shop, St. Thomas, Ont. Loss, $1,000.

THE "Societe de l'Industrie Minerale" of Saint-Etienne, France, invites original communications from its members on mining, metallurgy and mechanics, for which the Council will award premiums varying from five hundred to one thousand francs. The subjects to be dealt with are: in the mining section, the working of thick-coal seams, and underground haulage by compressed air or electric locomotives; in the metallurgical section, the methods for removing dust from combustible gases, the manufacture of open-hearth steel, and the utilization of the waste heat of furnaces for steam boilers; and, in the mechanical section, the use of high pressure, cut-off gears, compounding and condensation in winding engines, and the employment of superheating in steam engines. The papers must be written in, or translated into French, and must be in the secretary's hands by December 31st, 1897.

* Table of the horse power of transmission rope, reprinted from the transactions of the American Society of Mechanical Engineers, vol. xii., page 230, article on "Rope Driving," by C. W. Hunt. The working strain is 800 lbs. for a 2-inch diameter rope, and is the same at all speeds, due allowance having been made for loss by centrifugal force.

PEAT FUEL ON RAILWAYS.

Editor CANADIAN ENGINEER:

In your number for last month there is an article by Herbert Wallis, late mechanical superintendent of the Grand Trunk Railway, on the "Efficiency of Coal Consumption in Railway Practice," in which he makes a comparison between wood and peat as fuel for locomotives; as it stands in Mr. Wallis' paper, peat is made to appear of 50 per cent. less value than wood, a statement which is misleading and requires qualification. I am interested in peat, and have been engaged in its manipulation, more or less, for thirty years, and cannot allow that statement to go forth and remain unnoticed.

Archibald Blue, director of the Bureau of Mines of Ontario, in his report for 1891, has an exhaustive chapter on "Peat, its Use and Value for Fuel." At page 206, speaking of Mr. Wallis' report on his trial with peat, he says: "It is evident from the result of these experiments that the peat which Mr. Wallis had under trial was of inferior quality, and although it is stated to have been compressed, the fact that he objects to it on the score of its losing materially in weight, shows that it cannot have been properly dried. No one could pit green or air-dried peat against dry, hard maple or Welsh coal with the expectation that it would compare favorably with them. The tests appear to have been fairly and carefully made, but if the peat was not a representative article in point of quality, as is probable was the case, they ought not to be considered as conclusive evidence of its inferiority to the other fuels with which comparison is made."

I can speak with some confidence in corroboration of the deduction arrived at by Mr. Blue as to the quality of the peat used by Mr. Wallis in 1875, the year in which he says his observations were made. The year 1874 was a very favorable year for peat operations, and the Canada Peat Fuel Co., who supplied the peat used on the G.T.R., made a much larger quantity than usual, insomuch that their storage sheds and drying beds were completely filled. The Grand Trunk Railway Co., according to their agreement, were to remove 300 tons per day, but they failed to remove more than 60 or 70 tons per day, consequently there was no room to complete the curing of the peat during the short summer season, and a large quantity, some thousands of tons, was imperfectly cured and was partially frozen during the following winter. A curious feature of peat when condensed by maceration is that if it is allowed to freeze in a partially dry state then thawed and the drying completed, it loses density and weight and returns to its original spongy state.

The larger quantity which had been stacked or stored for the winter incompletely dried, was frozen and then dried the following summer of 1875, was of a loose spongy nature, and had lost that density and hardness which would enable it to resist the blast of a locomotive, and this was the peat used on the locomotives of which Mr. Wallis speaks. There was another reason why the peat did not compare favorably with wood: the fire grates and blast were not altered to suit the peat, but were used indiscriminately as for wood. Numerous trials on the Grand Trunk Railway with fairly good condensed air-dried peat, under careful usage, gave results of from 45 to 55 lbs. per mile.

DAVID AIKMAN.

St. Lambert, April 20th, 1897.

SEWAGE DISPOSAL.

We have received the following letter from the International Water and Sewage Purification Co, Ltd., London, Eng, and we append a letter by the author of the article complained of, which gives his explanation of the subject.

Editor CANADIAN ENGINEER.

DEAR SIR,—We have had brought to our notice the March number of your valuable journal, in which there appears an article on "Sewage Disposal," by W. M. Watson, Toronto, from which it is evident that the writer of the paper has confused the porous carbon process of sewage treatment with the ferrozone and polarite process of the International Water and Sewage Purification Company. It is stated in the article that in the porous carbon process "the sewage is clarified by a precipitant named ferrozone, and then passes through a filter containing polarite. This method has been severally criticized in England. . . . it is stated that the Porous Carbon Co. was offered every facility to prove the efficiency of its system at the town of Liecester, England, but they had utterly failed to produce a telling effect." From the above extract it will be seen that it is only right that you kindly allow us space to correct the error into which the author of the article has fallen by mistaking the Porous Carbon Company for the International Water and Sewage Purification Company. The International Company are the sole proprietors of ferrozone and polarite; the Porous Carbon Company, which has now ceased to exist, used materials entirely different from those of this company.

The International system includes all the latest improvements for the efficient and economical treatment of sewage, and has been adopted at over 300 towns and places in this country, and is in most successful operation at a great number of sewage works, purifying all kinds of sewages. Her Majesty's Government have had it in use for the past six years with entire satisfaction, and its adoption is being extended to all parts of the world. We would like to say that at Liecester the International system was demonstrated with complete success after the Carbon Company's process had failed, and the following is an extract from the report of the medical officer of health of that town:

"*Re Polarite Filter.*—We have had constructed at our sewage works an experimental filter of the above material, which has undoubtedly yielded better results than any of the numerous processes adopted here. It gave a filtrate which remained free from putrescence or appreciable smell after being kept continuously at a temperature of over 70° Fahr. for three weeks." The report further adds that the filtered effluent remained free from smell or unpleasant odor, even when exposed for three weeks hot weather in a large tank to the sun and air. Fish also lived in it, a striking proof of the comparative purity of the water.

When we mention that such towns as Middleton, Nelson, Wednesbury, Royton near Oldham, Maidenhead, Bowness on Windermere, Failsworth, Blackburn, Darwen, Chorley, Crompton, Melton Mowbray, etc., etc., as well as the Home Office and War Office Departments of H. M. Government have adopted the ferrozone and polarite process, and that it has been favorably reported on by some of the most eminent scientists and sanitarians of the day. We trust we have made it clear to your readers that, instead of being a failure, the International system is a highly successful, and the most economical method of treating a town's sewage, as is proved by its very extensive use.

The Engineer in Chief to the Local Government Board of England, Major H. Tulloch, R.E.C.B., has inspected the International process in operation at several sewage works, and the following is a copy of the opinion he expressed:

"The results are most excellent. The sewage was very strong, but the effluent from the polarite filters was most beautifully clear, and without any smell or taste."

We are, yours obediently,

THE INTERNATIONAL WATER & SEWAGE PURIFICATION CO., LTD.

Editor CANADIAN ENGINEER:

DEAR SIR,—Replying to the letter from the International Sewage Purification Company, dated March 27th, I may say that I am not confused, for I believe I rightly understand the International Company to be a new name for the Porous Carbon Company, which they very properly say ceased to exist when they registered themselves as the International Water and Sewage Purification Co., and that what ever kind of percipitant they thought it necessary to use for clarifying sewage they alone should be allowed to call the chemical ferrozone and the material used for filtering, polarite. This statement may be proved by referring to their own advertising pamphlet, page 5, where they say that the polarite filter beds at Acton sewage disposal works are now (1894) working as well and effectively after continuous use since 1887 (a date previous to the registration of the new name) as when they were laid down. Then turn to the report on the Treatment of Sewage made by Arthur Turley, Esq., C.E, of Leeds, England, dated 1890. On page 11 he reports that the porous carbon process has been working at Acton for some time and that the precipitant used is magnetic ferrous carbon—probably some of the same chemical that they now call ferrozone. He also reports that the cost of constructing the works was £400, and annual cost of management was £133 6s 8d. for each 1,000 of the population.

I have a copy of a report from Acton Local Board in 1892, stating that their sewage system was satisfactory, but that they would prefer irrigation. They do not contradict my quotation from the records of the civil engineers, but state that their system was demonstrated with complete success at Leicester. Now I have a copy of a letter before me written by the Leicester corporation, dated 1892, stating that they have lately disposed of their sewage principally by broad irrigation over a space of 1,400 acres of land, and that a portion of their old works was still treating sewage by undergoing a chemical treatment, by mixing six grains of the ferrozone and eight grains of lime to each gallon of sewage, but that

they intended to abolish the chemical system altogether when the land was all in working order.

If the International system, after years of trial, was such a grand success, why had not the Leicester corporation adopted the scheme in its entirety. The International Company, on page three of their pamphlet, speak strongly against using lime as a precipitant; but the Leicester people use eight grains of lime to six of ferrozone, and by this time will have given up using ferrozone altogether.

One reason why some surveyors and engineers, in England, criticize the International Co.'s sewage system, is because of the high cost of management and plant. Then it is generally understood, in fact the letter they have written for your publication shows, that they use the American methods of securing orders, and cracking up their business. To further prove this statement, I have a communication from Messrs. Duncan & Pickard, engineers, 89 Albion street., Leeds, England, informing me that in November, 1893, the International Company issued a circular, stating on the authority of W. Naylor, the Sewage Inspector to the Ribbe joint committee, that the Carbonizer Refuse Filter System of cleaning sewage only effected the removal of one per cent. of the organic matter, albuminoid ammonia, and that when they wrote to Mr. Naylor calling his attention to the erroneous statement, Mr. Naylor tested the effluent from the same works of the rival company, viz., the Carbonized Refuse System of sewage purification promoted by their clients, and found that there was removed from the sewage by that process over 62½ per cent. of albuminoid ammonia. This statement needs no comment. With reference to expert testimony, I will ask your readers to again look at the third paragraph of my article, page 326 of your March number. There is abundant proof that if a firm be rich enough they can secure plenty of favorable expert evidences. It may at present also be sufficient to show one proof.

On page 117, in the *Surveyor*, dated January 29th, 1887, printed in London, England, your readers can find that Dr, Riddle states that forty-five per cent. of albuminoid ammonia is removed by the new process lately introduced of cleaning sewage by allowing it to stand for a time in a dark tank. This is called the Septic System. Another noted expert named Dr. Voelcker, states that the effluent from the septic tanks is worse than the inflowing sewage, and that nothing whatever is removed by this process. Query--which of the two experts is speaking the truth?

I could give a large amount of information which I have received from England and Ireland referring to the International Purification Co., but it will be unfair to trespass on your space, and will conclude by drawing your attention to the fact that in none of the three articles on the subject which you so kindly put in your paper have I in any way mentioned the International Company's name; had I done so it would have acted as a free advertisement. Therefore I cannot see any cause for complaint against the paragraph mentioned.

W. M. WATSON,
Dundas street, Toronto.

LITERARY NOTES

The published Charter, By-Laws and List of Members of the Canadian Society of Civil Engineers for 1897, forms a little book worthy of the importance of that society. The society was established in 1887, and incorporated by Dominion Act in the same year. The statement of membership for the present stands as follows:

Honorary members	8
Members	271
Associate members	145
Associates	42
Students	121
Total	587

The officers of the society consist of a president, three vice-presidents, a treasurer, secretary, librarian, the past presidents, styled honorary councillors, and 15 councillors. The objects of the society are to facilitate the acquirement and interchange of professional knowledge among its members, and to encourage original investigation. In addition to this, there is evident a great desire to inspire a proper sense of the responsibility, and the code of ethics is admirably adapted to that purpose. It enjoins on every member the duty to perform the work he undertakes to the best of his ability, and in the true spirit of his engagement, feeling it his duty to present all ascertained facts in their true light. He must also loyally obey and support his chief. His reports must be full and explicit on all important points, and exact to the best of his knowledge, cloaking nothing, even though likely to show that previous reports have been inaccurate. He is also to avoid connecting himself with schemes of a merely speculative character, bearing in mind that his professional reputation will be judged largely by the inherent merits of the undertakings with which his name may be connected. The meetings of the society are now being well attended, the papers read before it are of a highly instructive and scholarly character, the library is growing beyond its allotted space, and since there is a respectable building fund the society may ere long be housed in handsome premises, with provision for the growth which may be predicted for so earnest and important an organization.

A first prize of $500 and a number of smaller prizes have been offered by The Century Co., publishers of The Century Dictionary and Cyclopedia, for the best answers to a hundred and fifty questions covering a broad range of information. A sample question, which is easier than some of them, is as follows: "What is the approximate difference in altitude between the loftiest Alpine summit and the bed of the greatest depression in the Mediterranean basin?" An additional prize of $500 is offered to any one who can answer 90 per cent. of the questions from any ten published works of reference other than The Century Dictionary and Cyclopedia.

We have just received the 1897 edition of the *Indian and Eastern Engineer* Diary, which is issued gratis to subscribers from 137 Canning St., Calcutta, and 28 Victoria St., London S.W. It is a substantial quarto volume containing all the internal evidence of a successful publication, interleaved and substantially bound. The information it contains is that which is most frequently required by engineers and the various trades allied to engineering. It includes the Christian, Bengalee, Fuslee and Mohammedan calendars; Indian railway, hotel, bank and club directory; the customs tariffs of Ceylon, China, Corea, England, Japan and Netherland India; English and metric weights and measures; Indian steamship lines; postal information; patent stamp fees and a wealth of technical data for professions and trades.

Walter G. Berg, of the engineering staff of the Lehigh Valley Railway, made an interesting speech before the New York Railroad Club during the discussion on G. B. Leighton's paper on "The Profession of the Railway and a suggested Course of Training therefor."

The Colliery Engineer Co., Scranton, Pa., proprietors of The International Correspondence Schools, announce that commencing with the February issue the name of the journal, *Home Study*, which they publish, will be changed to *Home Study Magazine*; the page will be reduced to magazine size, but the number of pages will be doubled.

Mining Matters.

THE gasoline engine is now operating the hoist at the R. E. Lee mine at Sandon, B.C.

THE Anglo Canadian Asbestos Co. has commenced to work its chrome pits at Black Lake.

THE Thetford, Que., asbestos mines are said to possess the largest deposit of that mineral yet discovered.

THE discovery of a bed of sand which assays nearly $500 per ton in gold, is reported from the Parry Sound district.

A. DICK, M.E., has recently inspected and surveyed the Rawdon gold areas owned by C. H. Dimock, Windsor, N.S.

DR. W. T. STUART, Toronto, is interesting himself in the introduction of the Beams process of reducing the refractory ores of Hastings county, Ont.

CONSIDERABLE excitement was caused at Selkirk, Man., over some splendid samples of asbestos that were brought in from Lake Winnipeg by gold prospectors.

THE lithographic stone from W. H. Casement's quarries, near Lakefield, Ont., is said to be of a good quality, and recent tests pronounce it almost equal to European.

PREPARATIONS are being made for the construction of a 50-stamp reduction mill at the Dick and Bannim Water Power, Keewatin, and work will be commenced at once.

THE Joggins mine is now producing daily about 320 tons of coal, mined in such a way as to give perfect satisfaction to all consumers. Manager Archibald is putting in new boilers.—*Amherst News.*

THE Ottawa Gold Milling and Mining Co. propose to erect a large stamp mill at Keewatin. The promoters, among whom are John Mather and A. W. Fraser, of Ottawa, propose to expend $100,000.

THE township of Madoc, Hastings, derives an income from a hematite iron mine situated under the county road on lot 12 in 5th and 6th concessions. The mine was recently disposed of to A. F. Wood for a royalty of 60 cents per ton.

SELKIRK, Manitoba, reports say M. O'Donohoe and R. Smith returned home from the north a few days ago from a prospecting trip, and brought specimens of anthracite coal from the west shore of Lake Winnipeg, about 160 miles from Selkirk.

THE Broughton Mine, Danville, Que., owned by the Glasgow and Montreal Asbestos Co , was leased and worked the past season by the United Asbestos Co., and some of the best asbestos in the world was taken out, having a length of from six to seven inches.

TORONTO Tudor Gold Mining Co. has sold the Craig mine, near Bannockburn, to a company represented by J. D. Edgar, Oronhyatekha, M.D., and others, for $47,000. This is a mine that was purchased a few weeks ago from Peter Vankleek, James Maitland and others for $12,000.

IT appears to be beyond reasonable doubt that the silicious ores of Rossland are free milling and that at least 75 per cent. of the values can be saved on the plates and in the concentrates. Captain Hall, superintendent of Le Roi mine, has recommended the construction by his company of a 200-ton milling plant.

THE Canada Copper Co. is operating its Sudbury mines at a profit of ten per cent. The Cliff, Evans and Slater are the names of the three nickel mines now being worked by the company. On the cliff the shaft is down 700 feet, and in this mine there is said to be enough ore in sight to maintain the present output of ore—viz., 400 tons daily – for 60 years to come.

WHEN the people in the east recover from the circular insanity that caused them to buy so much wild cat stock last year, they will be wild with rage. As in the matter of prize fights, their own press is more to blame than the sharks from Spokane and other American cities who have worked their graft so successfully upon the fools of eastern Canada.—*New Denver Ledge.*

THE issue of shares at the price of a single dollar has been a good deal talked about, but a company has been formed in Dublin with shares of a par value of one penny. A director must own one thousand shares, the vale of which is a little over $20. The object of the company—which is called the Jehol Mining Co.—is to carry on mining operations "in Asia or elsewhere."—*Ex.*

THE Delaware and Mount Brydges Oil and Gas Company, Ltd., purposes to explore for petroleum. It has a capital stock of $10,000 in shares of $5 each, and is composed of Henry Johnston, Frank Haycroft, John McEwen and John Ackland Miller, of the township of Delaware, and Thomas Pearce, Geo. Bignall and John Howe, of the township of Caradoc, county of Middlesex, Ont.

THE Calgary *Tribune* says: A big gold-saving machine, occupying two freight cars, has arrived in Calgary from the east. It was billed as a "smelter," and is intended for extracting gold from the richly mineralized sands of the Saskatchewan River. It has been found that the old-fashioned method of gold-washing with grizzlies saved only 20 per cent. of the gold, and this accounts for gold continuing to be found in sand which has been worked over and over again. The present machine has been imported from Omaha, Nebraska. The owners took some of the black sand to their own smelter at Omaha, and found that it assayed as high as $268 to $280 to the ton.

DR. R. W. ELLIS was engaged during the past summer in the counties of Renfrew, Addington, Frontenac, Lanark and Carleton in Ontario. North of the Mississippi River, from Ardreh to Long Lake, there is an area in which silver-lead ore in paying percentages is to be seen. Gold is also found there, and although the appearances indicate pockety quartz, it is thought probable that fissure veins will some day be discovered, as there is every probability of the area of rock being identical with that found in Madoc and Marmora. This formation has in fact been pretty well traced and is found to end at the juncture of the Bonnecher and with the Ottawa River. Having its northern apex lying between this point and the town of Renfrew, the band has been traced in a generally southeasterly direction through the Country of Lanark into Leeds a few miles, Frontenac, Addington and Hastings; the main direction of good prospecting country being through the townships of Marmora, Madoc, Elzevir, Kaladar, Anglesea, Barrie, Clarendon, Palmerston, Lavant, Darling, Pakenham and McNab.

REPORTS from White River, some 300 miles east of Port Arthur, are very encouraging in their nature. Gold has been discovered in more than one instance, and it is also said that splendid samples of iron ore, going 62 per cent. metallic iron, have been brought in. If this thing keeps on every C.P.R. station along the line from Sudbury to Rat Portage will be turned into a mining camp. The list of stations and towns now recognized as mining or semi-mining camps includes White River, Jackfish, Schreiber, Nepigon, Ouimet, Port Arthur, Fort William, Finmark, Savanne, Bonheur, Ignace, Wabigoon, Rat Portage.—*Toronto World.*

THE statistics of the mineral production of the United States, which appeared in our last issue, were reprinted from *The Engineering and Mining Journal*, New York, which publishes the mineral statistics about a year before the government, and which are much more accurate and complete than those collected by the United States Geological Survey, a fact so well known that the British Government has adopted these statistics exclusively in its blue books, and the French Government also uses them. It was quite an achievement to be able to publish January 1st, the statistics of mineral production for the whole United States up to the 31st December, 1896, as the *Engineering and Mining Journal* did.

J. B TYRRELL, of the Dominion Geological Department, says of the country north of Lake Winnipeg that "around Herb Lake large masses of eruptive grey and red granite were found, through which run many quartz veins, associated with a good deal of iron pyrites. On Reed Lake, near by, the green slaty rock is cut by many stringers of quartz. The same is true about Cranberry Lake, also near by. "This area of Huronian rocks," says Mr. Tyrrell, "extending about 75 miles from east to west, and an unknown distance toward the north, presents a good field of exploration for the prospector for gold and other precious metals, on account of the number and variety of eruptive masses that break through it, surrounded by zones of highly disturbed and fissured rocks."

A LETTER has been received from William Ogilvie, the Dominion Land Surveyor, dated January 11th, 1897, and has just come to hand. He says that Thos. M. O'Brien, a merchant of Forty Mile, intends going to Ottawa, and he took the chance of sending an interim report along with him. He reports that the prospects of the Clondyke are still very encouraging. "So much so in this case," he says, "that all the other creeks are practically abandoned. Especially is this so in regard to Forty Mile, in American territory, and nearly one hundred men have made their way from Circle City. Those who cannot get claims are buying in on those already located. Men cannot get anyone to work for love or money, so scarce are laborers, and development is consequently very slow. One dollar and a-half per hour are the wages paid. A few men work for higher wages, and they are permitted to remain on duty as many hours as they please. Some of the claims are so rich that over night a few pans of dirt suffice to pay the hired labor. As much as $204 has been reported in a single pan."

IN the anuual reports of the School of Mining, Kingston, Ont., Prof. Goodwin, director, reports a great advance made; 502 students have attended classes in the science hall, and the graduates had all obtained positions in mining work. Thirty had taken the winter prospector's course of eight weeks, and these embraced civil engineers, surveyors, experts and graduates of other science schools. Over 300 had attended the ten outside classes in as many parts of Ontario last summer and fall, under Profs. Merritt and Miller. Instructors Pope and Brock were about to leave, the former to study in Germany under a valuable scholarship, and the latter to join the Government geological survey. Prof. Nicol would return from Germany in August to resume his work. The elections for the ensuing year of the Board of Governors resulted as follows: E. W. Rathbun, Deseronto; James Haydon, Camden; A. Barnet, Renfrew; Hon. Wm. Harty, James Swift, E. J. B. Pense, John McKelvey, G. M. Macdonnell, Robert Crawford, G. Y. Chown, W. B. Carruthers, William Mickle, Kingston. Alds. Livingston and Donnelly represent Kingston city council and Warden Taggart represents the county council.

AT the meeting of the Federated Canadian Mining Institute during the discussion on the C. F. Andrews' paper, "Notes on the Mining of Low Grade Ores in Nova Scotia," J. F. Lewis, of the Rand Drill Co., said: "This paper is very interesting to all of us, especially to those interested in Nova Scotia, for the reason that it proves conclusively that the low grade ores, which are so abundant —not only in Nova Scotia but in British Columbia—can be mined and milled cheaply enough to make such mines pay the investors. It is no doubt very creditable to the management that they are mining this rock at $1.65 per ton, but I wish to suggest that without question it can be mined even cheaper than that, by putting in

proper machinery for breaking the rock. I would cite as an instance the Atlantic Copper Mine in Lake Superior—the rock carrying only .64 of 1 per cent. copper. They are raising this ore 3,000 feet; hauling it four miles by railway train; putting it through the stamp mill for $1.12 per ton, and they expect to get the cost of it down this year to $1 per ton, therefore I think this paper should be a great encouragement to those interested in low grade ores, and also an incentive for every mine manager to produce his ore cheaply."

FROM a report which has been issued by the Geological Department it appears that the future of the natural gas industry, in the opinion of the mining expert, is very doubtful. It is pointed out that the rock pressure in the wells in Essex county shows no marked decrease, but this is attributed to the recent date at which the consumption became other than of a local character. There have been twenty-six wells drilled, of which sixteen are still active producers. The rock pressure is given at 400 pounds to the square inch, and the estimated output is 35,000,000,000 cubic feet per annum. A very different condition of things is reported to exist in the Welland gas fields, from which Buffalo draws its supply. As to that district the report continues: According to the opinion expressed by several of the leading authorities on the subject, it would appear to be merely a question of a few years before the gas supply in the Welland field will be exhausted, at least for commercial purposes, though a small flow may still continue for a much longer period, which will be of service for domestic uses to farmers and others with wells on their premises and requiring only a very limited daily supply. In support of this opinion, mention may be made of the Provincial Company's well No. 63, drilled in 1893, which yielded when the gas was struck a flow of 10,000,000 cubic feet per day. The flow from this well has now decreased to such an extent that it does not produce 400,000 cubic feet in the same time, although it has in the interval been several times fed from the other wells.

Marine News.

CAPT. BOURMAN has charge this season of the ferry steamer "Janet Craig," Arnprior, Ont.

THE Rathbun Co., Deseronto, Ont., will, it is said, put a boat on the Brockville-Gananoque route.

OSCAR DAKIN, Digby, N.S., the first officer of the Government steamer "Newfield," has been relieved of duty.

AN influential deputation waited on the Dominion Government urging the claims of the Rideau canal to improvement.

W. H. EMBREE & SON, Port Hawkesbury, Cape Breton, recently supplied a steam yacht to J. Robinson, Newcastle, N.B.

THE B.C. Iron Works, Ltd., Vancouver, B.C., is now placing in position the engines in the new C.P.R. steamer at Rosebery, B.C.

THE Pembroke Navigation Company is asking for incorporation. The capital stock is $40,000, and Hon. Peter White is one of the directors.

CAPTAIN W. O. ZEALAND commands the McKay steamer, "Michigan," which was rebuilt at Port Dalhousie. Jas. Belanger is chief engineer.

THE Hamilton Steamboat Co.'s str. "Macassa's" officers this season are: A. Crawford, captain; L. Walsh, first officer; Purser Arthurs and Engineer Durham.

SUPT. ELLIS, of the Welland Canal, has been superannuated, and W. G. Thompson, superintending engineer, will combine his duties with that of superintendent.

DAVIDGE & Co., of Victoria, B.C., are asking a yearly bonus of $100,000 for four years to establish a monthly service between Victoria and Central America and Mexico.

THE contract for dredging Collingwood, Ont., harbor has been awarded to Boon, Armstrong & Company. One of the most powerful dredges in the lakes will be employed.

HON. A. G. BLAIR, Minister of Railways and Canals, has made the announcement that all the St. Lawrence canals will be enlarged to a depth of fourteen feet by the spring of 1899.

THE Wahnapitae Navigation & Transportation Co., Ltd., applies for an Ontario charter; chief place of business, Sudbury, Ont.; capital, $50,000. The incorporators are A. Gordon, F. Cochrane, D. O'Connor, F. Hamilton, Sudbury, Ont., and I. Eastwood, Wahnapitae, Ont.

CAPT J. S. MOORE will be in command of the "Leonard Tilley," of the McKay line, and James H. Brown will be first engineer. Richard Freeman will be captain on the T. C. Merry.

THE Pembroke Navigation Company has given orders to the Polson Iron Works, Toronto, for a new steel steamer to ply on the Ottawa River between Pembroke and Deux Joachims, to be ready about July 1st.

DURING a gale on the St. Lawrence, April 26th, the steamer "Rosedale," of the St. Lawrence and Chicago Steam Navigation Company, loaded with grain, ran aground and damaged her hull. She is docked at Kingston.

THE following have been appointed officers on the Dominion Government cruiser "Petrel": Capt. E. L. Dunn, first mate A. J. Frame; second mate, F. Arnold Jarvis, chief engineer, A. J. Brown, second engineer, W. H. Linter.

THE first vessel to lock through the Welland Canal this season was the Canadian schooner "Wawanosh," for Toledo. She was followed by the steamers "Rosedale," "Algonquin," "Niagara," "Bannockburn," and "Erin."

THE officers appointed to vessels by the Merchants Line G. E. Jacques & Co., Montreal, Can., are as follows: Steamers "Cuba," Capt. H. Chestnut, Engineer, E. L. Foley; "Melbourne," Capt. R. Chestnut, Engineer, Thos. Milne.

The *Algoma Pioneer* says: It is now proposed to establish a line of boats to Manitoulin Island, with headquarters at the Sault, and make this the depot for the valuable products of the islands and north shore, instead of carrying them to Collingwood, etc.

THE "Massena," a steamer plying between Brockville, Ont., and Ogdensburg, during the storm on April 19th, was run into Maitland, but while tied up at the wharf her upper works were knocked in by the storm, and she sank. She was loaded with oats, lumber and cement.

DUNBAR & SULLIVAN, Welland, Ont., have recently launched a scow for use on the Lachine Canal, capable of carrying 600 cubic yards of earth. It is one hundred and twenty five feet, by twenty-eight feet beam and eleven feet sides, built in six pockets. Each pocket is lined with steel and has two steel doors, weighing 4,200 pounds each.

CAPTAIN DELANEY, of the str. "Grand Lake," has, it is said, been asked to take charge of R. G. Reid's new fast steamer to run from Sydney to Newfoundland to connect with the western terminus of the Newfoundland railway, which is being hurried forward on the Clyde. It will be about 1,200 tons in size, and capable of steaming 16 knots.

THE officers appointed to vessels by A. W. Hepburn, Picton, Ont., are as follows: Steamers—"Alexandria," Capt. B. Smith, Engineer Chas. M. William; "Empress of India," Capt. Geo. O'Brien, Engineer M. Tetro; "Aberdeen," Capt. M. Heffernan, Engineer George Gown; "Water Lily" to be appointed. Schooner—"Onteora," Capt. Homer Perron.

THE Collins' Bay, Ont., Rafting & Forwarding Company, Ltd., has placed the following captains and chief engineers in charge of their steamers and vessels: Str. "Orion," Capt. Alexander Milligan, Engineer Wm. Spencer; str. "Saturn," Capt. Alexander Anderson, Engineer Wm. Kennedy; str. "Rival," Capt. John A. McDonald, Engineer Z. Hamlin; str. "Petrel," Capt. McDonald, Engineer Joseph Branch; barge "Muskoka," Capt. Patrick Gallagher; barge "Waubaushene," Capt. Henry Milligan; schr. "S. Neelon," Capt. Charles Beaupre.

THE wreck of the Beaver Line chartered steamer "Assaye," on the Blonde Rock, off the Seal Islands, on the Nova Scotia coast, took place on April 5th. The steamer was coming from Liverpool to St. John, N.B., with a general cargo and passengers, the whole ship's company numbering 65. She is a steel screw, four-masted steamer with a gross tonnage of 5,129 tons, and a net tonnage of 3,981 tons, and classed 100 A 1 at Lloyds. Seal Island lies at the western point of the triangle formed by Pubnico Harbor light, Bon Portage light and its own light, being almost midway between Cape Sable and Tusket light, but off from the coast.

MORAN BROS., Seattle, Wash., propose to build steamers at Seattle, take them to the head of Lynn Canal in Alaska in sections, pack them over the mountains to Lake Bennett, in British territory, a distance from the head of Lynn Canal of about thirty-one miles, and there assemble the vessels and navigate the chain of lakes and rivers to and down the Yukon River to the gold fields. This, it is claimed, will offer a very practicable route to the new gold fields, and the trip can be accomplished in about two weeks from Seattle, whereas it now requires about two months or longer to reach the same destination by way of the mouth of the Yukon.

OTTAWA RIVER NAVIGATION Co. has appointed the following officers for its fleet for the season: Str. "Empress," Capt. A. Boure, Engineer Geo. Menish, 2nd Engineer Geo. Hodgson; str. "Sovereign," Captain H. W. Shepherd, Engineer J. F. Marchand, 2nd Engineer Thos. Therault; str. "Duchess of York," Capt. J. McGowan, Engineer A. Menish; str. "Princess," Capt. P. McGowan, Engineer F. Piche; str. "Maude," Capt. E. Gauthier, Engineer N. Fugere.

MANAGER FOY, of the Niagara Navigation Company, has appointed R. Clapp first officer of the "Chicora," to the captaincy of that vessel, in place of the late Capt. Harbottle, deceased. Captain Clapp has been with the Niagara Company since 1893, occupying the position of chief officer. Previous to that he was first officer on the "Empress of India" under Captain Solhmes, now of the "Corona." The new captain has selected as his first officer, C. Smith, who last year was second officer of the "Chippewa." W. Palen will again act as second officer, and H. Parker, engineer.

IT is very gratifying to Canadians generally to note the remarkable developments of the winter traffic at the port of St. John, N.B., and the evidence that a Canadian harbor can compete with the United States ports. While there has been a development of about 50 per cent. in the traffic during the present season over that of the preceding winter, the local manager of the Canadian Pacific Railway states that the business has only been limited by the amount of ocean tonnage offering; also that if the steamers had been available, the business would have doubled that of the present season.

THE following are the officers of the fleet which wintered at Deseronto, Ont., for this season: "Resolute," Capt. John Gowan, N. Palmateer, Mate, J. Harrison, 1st Engineer, S. Larue, 2nd Engineer; "Reliance," Capt. Jas. Daugherty, Mate, B. Barnhart, Engineers, John Toppins and A. McKain; "Ella Ross," Capt. D B. Christie, Mate, P. Farrington, Engineer, John McFaul, Purser George McGaughey; "Deseronto," Capt. Wm. Skillen, Mate, G. Arthurs, Engineer, J. Rice; "Rescue," Capt. John Rowe, Engineer, M. McFaul; "Nile," Capt. W. Daly, Engineer, Jas. Quigley; "Armenia," Capt. S. Anderson, Engineer, Rice; "Ranger," Capt. M. Woodcock, Engineer, McKain; "Norah," Capt. D. McVicker, Engineer, Toppins.

THE Richelieu and Ontario Navigation Co. has made the following appointments of officers for the fleet for the season. The list is complete as far as appointments have been made:—Steamer, "Algerian," captain, A. Dunlop; mate, Dan. Mills; 1st engineer, T. Wadsworth; 2nd engineer, G. Bourk; purser, — Dubois. Steamer "Berthier," captain, Chas. Gouin; 1st engineer, — Arcand; purser, G. Paulet. Steamer "Canada," captain, Thos. Dougall; mate, E. Duguay; 1st engineer, Ed. Dennis; 2nd engineer, — Matte; purser, F. Wurtele. Steamer "Chambly," captain, — Tranchemontagne; mate, — Robillard; 1st engineer, Chas. Gendron. Steamer "Corsican," captain, — Esford; mate, — Bushell; 1st engineer, Wm. Parker; 2nd engineer, — Guibault; purser, — Boyle. Steamer "Hamilton," captain, — Baker; mate, — Graves; 1st engineer, Wm. Black; 2nd engineer, Alex. D'Martigny. Steamer "La Cultivateur," captain, — Raymond; 1st engineer, — Noel. Steamer "Montreal," captain, L. St. Louis: mate, P. Kane; 1st engineer, H. Hamlin; 2nd engineer, E. Beaudoin; purser, J. O. Prevost. Steamer "Passport," captain, J. McGrath; mate, — Corrigan; 1st engineer, Alex. Milne; 2nd engineer, A. McBride. Steamer "Quebec," captain, L. O. Bouchier; mate, — Rocher; 1st engineer, Frs. Gendron; purser, L. Gorman. Steamer "Saguenay," captain, Geo. Riviere; mate, — Fortin; 1st engineer, — Lacroix; purser, J. Lapierre. Steamer "Spartan," captain, — Grange; mate, I. Carway; 1st engineer, Ned. Taylor; 2nd engineer, T. Noble; purser, — Tandy. Steamer "Terrebonne," captain, — Laforce; mate, — Laviolette; 1st engineer, Geo. Gendron; purser, — Masse. Steamer "Three Rivers," captain, F. St. Louis; mate, F. Ladibouche; 1st engineer, Johnny Matt; 2nd engineer, P. Papineau. Steamer "Fire Fly," captain, — Crepau; 1st engineer, P. Bouchey. Steamer "Longueuil," captain, — Jodoin; mate, — Laurin; 1st engineer, M. Beadett; purser, F. Brossard. Steamer "Sorel," captain, — Berthiaume; 1st engineer, — Beaucage. Steamer "Hochelaga," captain, — Mandeville; mate, — Poulett; 1st engineer, C. Chapdeline. Steamer "Laprairie," captain, — Coursel; mate, — McClean; 1st engineer, — Beaudoin; purser, Geo. Brossard. Steamer "Island Queen," captain, — Moneau; 1st engineer, Jos. Matt; purser, M. Gill. Steamer "River du Loup," captain, — Faubert; 1st engineer, — Gouin.

Electric Flashes.

IT is proposed to develop power at the Nigger Rapids, Magog, Que.

THE $5,000 bonus voted by Perth to the proposed Perth-Lanark road has lapsed.

WORK was begun on the Slocan City—New Denver, B. C.—telephone early last month.

AN electric line is projected to connect St. Catharines and the H., G. & B. at Beamsville, Ont.

THE Rat Portage Electric Light Co. has its new generators for arc lighting and power running.

WORK on the Quebec Street Ry. is now being pushed, and the road is expected to be in part operated by June 22nd.

S. DOUGLAS, Stanley, N.B., is putting in an electric lighting plant which will light the village as well as his own premises.

JOHN GRAHAM, Toronto, recently recovered $300 damages from the Street Railway for being pushed off the cars by an employee,

THE Portage la Prairie power scheme was killed by the refusal of the legislature to allow the town's issuing the bonds necessary to carry it out.

THE citizens' committee of Fort William, Ont., has reported to the council in favor of an electric lighting and water supply plant to cost $42,000.

THE effects of the Holmes Electric Protection Co., Montreal, were sold by the liquidator at public auction, and were purchased by Alexander Foster for $3,400.

G. C. HUEBNER, Detroit, and J. N. Vandegrift, Philadelphia, have, it is said, decided not to build an electric road from London to Port Stanley, as it would not pay.

THE Montreal Belt Line, the electric railway which runs from Maisonneuve to Longue Pointe, Point aux Trembles and Bout d'l'Isle, has secured the mail contract between these places.

IN Davis vs. Ottawa Electric Ry. Co., the Divisional Court has justified the company's employees in ejecting a passenger who violated the company's rules by sitting with his feet on another seat.

THE Lachine Hydraulic and Land Co. has made a contract with the Standard Light and Power Co., Montreal, for the delivery of 1,000 electrical horse-power which the latter will deliver to its customers.

THE ratepayers of Dartmouth, N.S., are asked to provide the following sums: $5,000 for improved sidewalks and water and sewerage extensions; $1,500 for repairs to the steam fire engine, and $50,000 for purchasing the plant of the electric light company.

THE Windsor Electric Railway Co. is said to be anxious to secure the charter of the proposed line from Sandwich to Amherstburg, Ont., because it has already got a charter from Amherstburg to run a track along the lake front to Kingsville and Harrow and to other points.

THE Hamilton council will not grant the Cataract Power Co. permission to erect poles and string wires till more definite information is furnished as to the company's plans. It is said that the company intends to draw its supply, not from the Decew's Falls, but the old Welland Canal.

AT the annual meeting of the shareholders of the Hamilton Radial Electric Railway Company, the following board of directors was elected: A. Turner, president; T. E. Leather, vice-president and managing director; S. E. Malloch, secretary; John Moodie, James Dixon, T. H. Watson and Geo. S. Lynch-Staunton.

WATERLOO, ONT., citizens are about to adopt incandescent lighting for their places of business and residences. Two companies in the field to supply the lighting. The Gas Company, with an incandescent system, and a newly formed association called the Waterloo Electric Light Co., Wm. Snider & Co., millers, will furnish the latter electric power.

A. J. CORRIVEAU, who was the chief promoter of the system of electric railways which now covers the Island of Montreal, is interested in a scheme to build an electric railway from St. Lambert or Longueuil, opposite Montreal, to points in eastern Quebec not touched by the trunk line railway, as far as Sherbrooke, with crossing powers over the bridges, ultimately connecting with the railway systems at Newport, Vt. The company also propose to put electric launches on the River Richelieu, to run from St. John's to points

on Lake Champlain. The whole system will cover something like 150 miles, and the power is to be supplied by the Chambly Rapids Water & Power Company.

A TORONTO syndicate, which has been securing options on the stock of the Street Railway Company and other lines, of Hamilton, Ont., has laid before the city council a proposition looking to the control of the electric railways in that city. It is proposed that a company, to be known as the Hamilton Franchise Company, shall be formed to acquire from the syndicate the property upon which it has options, including the Hamilton and Dundas Railway. The syndicate will accept its pay half in stock of the company and half in bonds. The interest on these bonds is to be first charged on revenue of the company; then at 6 per cent. dividend on stock, after which the city is to receive all the balance of the net revenue up to $20,000, when the stockholders may receive another 1 per cent., and the city all the remainder. The city is to relinquish its mileage and percentage on the Street Railway earnings, which now amount to about $14,000 annually. The city will have the right to appoint certain directors in the new company. It is probable considerable discussion will take place before the deal goes through.

W. A. JOHNSON ELECTRIC COMPANY, 34 York street, Toronto, report the following sales made during the last 60 days, and not previously reported: Thomas B. Angus, Kingston, Ont, one 3 h.p. motor; Theo. Frederick, Ottawa, Ont., one 1 h.p. motor; Antelope Bicycle Works, Toronto, 12 h.p. motor; Nasmith & Co., Toronto, 4 h.p. motor; D. Hibner & Co., Berlin, 150 lt. incandescent plant; W. J. Miller, saw mill, Thessalon, Ont., 30 lt. incandescent plant; Grip Engraving Co., Toronto, four 8 h.p. motors; Murray Printing Co., Toronto, four 3 h.p. motors; Luxfer Prism Co., Toronto, our 600 ampere dynamo for depositing copper; Luxfer Prism Co., Toronto, one 4 h.p. and one 6 h.p. motor; McLaren & Co., St. Catharines, one 3 h.p. motor; Rat Portage, Ont., two 3 h.p. and one 5 h.p. motor; New Denver Electric Co., 500 lt. incandescent plant complete; Rat Portage Electric Co., 100 arc light automatic dynamo and lamps; Rat Portage Electric Co., one 4-panel marble plug switch board, 12 x 5, for four alternating dynamos and eight circuits and for one arc dynamo, and one power generator; Waterloo Electric Co., 1,000 light incandescent plant complete, with wiring for residences, stores, etc., 25 lt. arc plant complete, with long burning arc lamps, one marble switch board; Macgregor, Gourlay & Co., Galt, two power generators, two 8 h.p. motors, two 6 h.p. motors and wiring for 250 incandescent lamps, one marble switch board panel. The W. A. Johnson Electric Co. further reports many sales of long burning arc lamps for direct and alternating circuits, "chloride" accumulators, Wagner transformers, etc.

Railway Matters.

THE Township of Russell, Russell county, Ont., has voted a bonus of $10,000 to the Ontario Pacific Ry. Co.

THE Restigouche and Victoria Railway Company is applying for an extension of time in which to complete surveys and begin construction.

THEOPHILE PERRAULT, Montreal, contractor, has sued C. N. Armstrong and John Rankin and the Pontiac Junction Railway Company for $788,754.

THE Lake Dauphin Railway will be extended to Mossy River this year, it is said. The company also expect to make further extensions in 1898, probably to Swan Lake district.

THE Canadian Pacific Railway Company is now constructing, at Perth, Ont., one hundred refrigerator, ten furniture and sixty dump cars, the work on which is being rushed as rapidly as possible.

THE people of Cobourg, Ont., are asking for a subsidy for the Cobourg, Northumberland and Pacific Railway, a line projected to run from Cobourg to Central Ontario Junction on the C.P.R., a distance of 50 miles.

AN equalization of power is being made on the G.T.R. All the heavy locomotives are being sent to run between Belleville, Ont., and York, where the grades are the heaviest. The lighter engines will run east of Belleville.

J. H. N. MACLEOD, civil engineer for the Canadian Pacific Railway, has charge of a large and thoroughly equipped survey party which is locating the line of the Crow's Nest Pass road westward from Lethbridge, says *The Nelson Miner.*

THE Nanaimo-Alberni Railway Company, composed of Andrew Haslam, J. H. Davidson and others, is seeking incorporation for the purpose of constructing a railway about Alberni to Nanaimo, with power to operate telegraph and telephone lines, construct wharves, docks, etc.

THE Restigouche Railway and Bridge Company applies for an act of incorporation to construct and operate a railway from a point of connection with the proposed railway of the Restigouche and Victoria Railway Company, at Campbelltown, N.B., to a point on the Bay Chaleurs Railway in Quebec, and to construct maintain and operate as a part of said proposed railway a bridge across the Restigouche River.

JUDGE OUIMET gave judgment, April 12th, in the case of A. R. McDonald, ex-superintendent of the Intercolonial Railway, against Charles Riordon of St. Catharines, the estate of the late John Macdonald and E. Boswell. The plaintiff claimed a large sum as due him in connection with the construction of the Temiscouata Railway, and the court gave judgment for $197,000, with interest for seven years at 6 per cent. An appeal will be taken.

THE following directors were elected at the annual meeting of the C.P.R., held last month in Montreal: Sir Donald Smith, G.C.M.G.; Sir Wm. Van Horne, K.C.M.G., president, Thos. G. Shaughnessy, vice-president; Richard B. Angus, Montreal, Edmund B. Osler, M.P., Toronto; Sandford Fleming, C.E., C.M.G., Ottawa; Lieut.-Gov. Geo. A. Kirkpatrick, Toronto, Geo. R. Harris, Boston; Wilmot D. Matthews, Toronto; Hon. D. MacInnes, Hamilton; Thomas Skinner, London; J. W. MacKay and Gen. S. Thomas, New York.

AT the shops of the Canadian Pacific Railway at Hochelaga, Que., there will be built this summer twenty-one locomotives for the company's service, which will include two consolidated engines for the mountain section of the road; three compound, ten-wheel engines for the Pacific section, and four of the same kind for other sections of the line; six ten-wheel passenger engines for the western division, and six of the same for the eastern division. Five first-class passenger coaches, together with baggage, express and smoking cars, will also be manufactured for use on the Toronto, Hamilton and Buffalo section.

EDGAR FRENCH has been appointed assistant engineer of the G.T.R. western division, with office at Detroit, in place of G. Masson, retired.

R. W. BROCK, M.A., acting lecturer on mining and assaying in the Kingston School of Mines, has been appointed geologist on the Dominion Geological Survey, at $1,100 per year.

E. P. HANNAFORD, civil engineer, whose services were dispensed with some time ago by C. M. Hays, manager of the Grand Trunk Railway, when he was inaugurating changes on the road, has taken an action for six thousand dollars against the G.T.R. for wrongful dismissal.

AMONG the prominent engineers who came from the United States to Montreal to tender for the construction work on the Victoria Bridge enlargement were: Messrs. Bonzano and Clarke, New York; L. E. Todd, C. W. Bryan, S. P. Mitchell, and W. H. Cornell, Wilmington, Del.

LEWIS CARVELL, who in the early days of the Intercolonial Railway occupied the position of general superintendent, died April 13th in Toronto. Mr. Carvell's connection with the road dated back before the advent of the McKenzie Government. After some years' service he was succeeded by C. J. Brydges.

Industrial Notes.

AN hospital is proposed for Oshawa, Ont.

WALKERTON, ONT., will build a new town hall.

GRANT & KERR's new sawmill at Ladner's Landing, B.C., is nearing completion.

THE Canada Paper Co. is to build a pulp and paper mill at the new dam, Windsor Mills, Que.

J. FLEMING, iron founder, St. John, N.B., recently turned out a five-ton cylinder for a marine engine.

P. MCMURRAY, Welland, Ont., has invented an acetylene gas generator, to cover which he has applied for a patent.

THE Webster Combination system of steam heating is handled in Canada by Darling Bros., Reliance Works, Montreal.

IT is said that the Grand Trunk moulding shops, at present located in Hamilton, Ont., will shortly be removed to London.

J. C. FOLEY & Co., of the Foley gold mines in the Seine River district, are putting in a new saw mill of 25,000 ft capacity.

THE Rathbun Co., Deseronto, Ont., has completed four fine passenger coaches for the Montreal Park and Island electric railway.

THE Goldie & McCulloch Co., Ltd., Galt, Ont., has supplied a 150-horse-power engine to the G T.R. for the car shops at London, Ont.

WALTER BEATTY, Pembroke, Ont., has the sub-contract for the carpenter work on the new C.P.R. car shops at Carleton Place, Ont.

WILLIS CHIPMAN, C.E., was recently engaged to value the plant of the Barrie, Ont., waterworks, which the town proposes to take over.

A LARGE cold storage warehouse is to be built at Halifax, N.S., by the Canadian Atlantic Cold Storage Co., Ltd. The Linde system will be used.

THE Ontario Legislature, at its last session, threw out the bill to amend the Ontario Architects Act, making the association virtually a close corporation.

THE Rathbun Company, Deseronto, Ont., has received an order for 25,000 barrels of cement from the Dominion Government, to be used in canal construction.

THE Masterman Sulphite Pulp Mill Miramichi, N.B., is to be operated for a short time for the satisfaction of representatives of intending English purchasers.

DARLING BROS., Montreal, are sole agents in Canada for the Webster system of steam heating, referred to in our article on steam heating on another page.

J. B. COATES, Ridgetown, Ont., and J. and R. Nichol, Blenheim, Ont., have gone into partnership in the manufacture of staves, hoops and headings, at Ridgetown.

WILLARD KITCHEN, Fredericton, N B., has been awarded the contract for the piers and masonry on the bridge over the Memramcook River at College Bridge, N.B.

THE Owen Sound Portland Cement Co. has secured the contract for 10,000 barrels of cement to be used by the Dominion Government on the St. Lawrence canals.

THE Wm. Hamilton Manufacturing Co., Peterboro, Ont., has the contract for equipping the new Howrie saw mill at Fenelon Falls, Ont.; capacity 150,000 feet per day.

BELLHOUSE, DILLON & Co., Montreal, have secured the contract for 20,000 barrels of Portland cement, to be used by the Dominion Government on the St. Lawrence canals.

IN return for a 25 year extension of its monopoly, the Winnipeg Gas Co. proposes to reduce the price of gas to $1 80 net for lighting purposes and $1 50 net for cooking purposes.

THE Canada Carriage Co., Ltd., Brockville, proposes to establish a branch establishment at Ogdensburg, N.Y., to evade the McKinley duties to be imposed by the Dingley bill now pending.

THE bursting of the fly-wheel of an engine used for threshing on the farm of J. R. McDonald, near Cornwall, Ont., recently killed the owner of the premises and seriously injured his brother.

THE firm of Albert Holden & Co, Montreal, dealers in railway and machinery supplies, in which line they succeeded to the business of Samuel Waddell, have assigned to the court. The liabilities are scheduled at $19,780.

THE Brotherhood of Locomotive Engineers of Canada will hold its annual union meeting in Windsor, Ont., in July, the exact date not having been fixed. About six hundred members and their wives are expected to attend.

JAMES A. CANTLIE & Co., woolen manufacturers' agents, Montreal, have abandoned their estate on demand of the Bank of Montreal. Liabilities about $200,000. A number of Canadian woolen mills will be affected.

THE Quebec Bridge Co. has elected the following directors: R. Audette, Mayor Parent, J. B Laliberte, H. M. Price, Hon. J. I. Tarte, H. J. Beemer, G Lemoine, C. Duquet, J. B. Forsyth, president, A. Lavigne and J. Breakey.

NOTICE is given of application for incorporation of the Lordly Furniture Mfg. Co., Ltd., St. John, N.B. The applicants are Joseph Allison, J. A. Likely, R. G. Haley, Isaac Burpee and S. B. Lordly. The capital stock is $20,000.

RECENT experiments made at the University of Nebraska Agricultural Experiment Station, U.S., on the relative values of coal and corn (on the cob), as fuel, showed that corn at 9 cents per bushel was equal to coal at $4.87 per ton.

THE Gilmour Co. are removing a large quantity of their sawmill machinery from Trenton, Ont., to their new mill at Canoe Lake, in the Algonquin Park. They have taken away eight of the sixteen boilers and more than half the saws.

AT a meeting of the creditors of E. D. Cotterette, hardware, Montreal, he made an offer of 20 cents on the dollar. The liabilities were shown at $20,575, partly mortgaged and privileged, and assets about $15,000, but largely depreciable.

THE Holland Emery Company of Tawas, Mich, has bought the site of the Georgian Bay Lumber Company at Byng Inlet, Parry Sound, Ont., and will, it is stated, build a couple of mills and docks and bring in from Tawas its complete plant.

R. DONALDSON & SONS, machinists and iron workers, Montreal, have assigned on demand. The concern failed only last July, on which occasion the estate was bought in, and the firm reconstructed. The liabilities then were $22,000; now they owe $9,400.

A RETURN brought down in Parliament recently shows that the bounties paid on iron and steel manufactured from Canadian ore since February, 1896, is as follows: On pig iron, 42,404 tons, $84,809; iron puddled bars, 4,353 tons, $8,708; steel billets, 35,757 tons, $71,514.

THE plant and good-will of the Safe Lock Metal Shingle and Siding Company of Smithville has been bought by a new company at Preston, Ont., formed under the name of the 'Metal Shingle and Siding Company." Cyrus Dolph, J. N. Clare, and H. D. Walker, all of Preston, are the first directors, and the capital of the company is $10,000. The new company started operations last month in the Preston Carriage Company's old building.

HIS Excellency Lord Aberdeen has accepted the office of patron of the Architects' Association of the Province of Quebec, as a mark of his appreciation and good wishes for the profession in general and for the association in particular. At a recent meeting of the association, William C. McDonald, Montreal, was elected as honorary member in recognition of his great generosity in founding, endowing and equipping a chair of architecture in McGill University.

PREPARATIONS are now being made in the townships of Faraday, Dungannon, Herschel, Monteagle, Carlaw, Mayo, Bangor, Wicklow and McClure, in the county of Hastings, and by the townships of Cardiff, Monmouth and Glamorgan, in Haliburton county, for the taking of a vote on a proposal to give a bonus of $80,000 to aid in establishing a charcoal iron smelter there. Providing the bonus is passed, Manager Pusey, of the Irondale, Bancroft and Ontario Railway, says the Philadelphia Engineering Works is prepared to at once commence the erection of a charcoal furnace to cost about $200,000 in the vicinity of some of the mines along the route of the I. B. & O. Railway.

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Isolated Water Works Planned and Installed. | Correspondence Invited.

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The Canadian Engineer

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THE QUEEN.

God save the Queen! The hymn and prayer resounds throughout the world. It is echoed from a greater number of lips and hearts than any invocation or national cry since mankind began to band themselves into nations. Her name is beloved and revered, not only by her subjects, now numbering 350,000,000 people, but by millions in other nations, who, rightly reading the history of the time, know our Queen to be a lover of peace, and to be animated by the spirit of goodwill to all peoples. Millions of citizens of the United States, though owning the rule of an elected sovereign, will join the prayer for long life to the Queen, and are to-day almost as much interested as we ourselves in this jubilation for the longest reign in English history, and the longest reign of any noted sovereign of a nation prominent in the history of the world.

In the eloquent outpourings of love and devotion that will thrill through the tens of thousands of presses and pulpits this month, it is quite possible to exaggerate the personal power and the personal attributes of our Queen. Beloved though she is, we have to acknowledge that she is but human. She has no doubt made mistakes, and yet there has been no important crisis in the Empire's history where her judgment has not been guided by sound sense, and in no instance—God bless her!—has her record been tainted by an expression of cruelty or oppression. Those who have read her "Reminiscences of Life in the Highlands," or her other books, must see internal evidence of a pure mind and simple life. Her spontaneous utterance when, as a young girl, she received the announcement that she was Queen of Great Britain—"I will be good"—was the natural expression of her heart's desire.

Now the remarkable thing about Queen Victoria's call to the throne is this: that if it had been a case of election by the people she would inevitably have been passed over. The nation would have fixed on some more striking and dramatic figure—not an inexperienced maiden of negatively good qualities, but a lady of some pronounced mental qualities with something of the dash of Queen Elizabeth. Yet, as our young Queen grew into a woman, it was seen that the very absence of those dashing and brilliant qualities was the evidence of a truer greatness. It was her common sense and that excellent balance of intellect that was to make her reign far outshine the glories of the age of Elizabeth. Time alone, in the ordering of Providence, could develop the high nobility of her character, forged in the fire of personal affliction, by bereavement, widowhood and all the moulding "changes and chances of this mortal life," through which she has passed. Thus no plan of popular selection of a ruler could have brought about a reign so long and so glorious, or so abounding with mutual affection between ruler and people.

And so all hearts may join in the stirring anthem composed for this special occasion by a Canadian, the Rev. G. J. Low, of Almonte:—

A NEW NATIONAL ANTHEM.

O Lord, our God, to Thee
All praise and glory be,
Thy power we own.
For Thou hast heard our prayer,
Her life in health to spare,
For three-score years to wear
This Empire's crown.

To-day, throughout the world,
In every breeze unfurled,
Her standard's seen;
From India's coral strand,
From Afric's golden sand,
Resounds the anthem grand,
God Save the Queen.

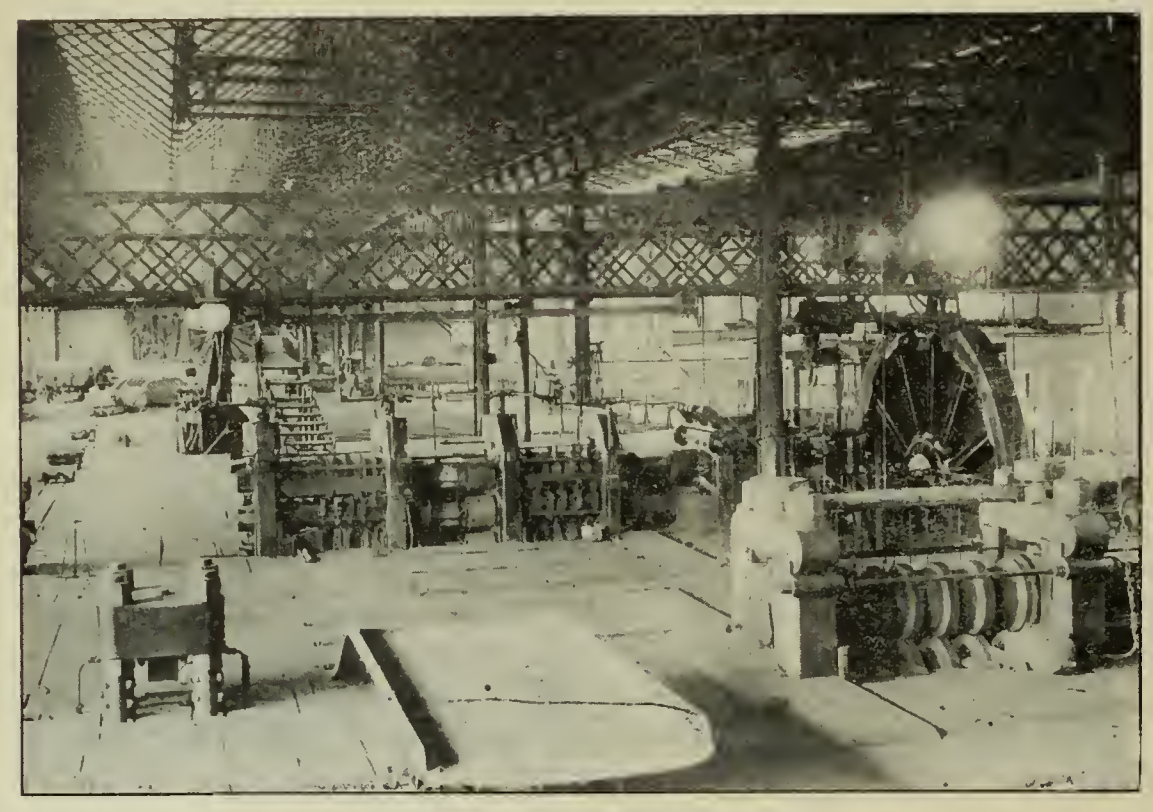
And Canada that links
The two great oceans' brinks,
Repeats the strain.
To keep our own wide land
Part of that Empire grand
We'll work with heart and hand,
With might and main.

Her Empire's vast increase
In power, in wealth and peace,
Her reign has seen;
Of ev'ry race and creed,
From all oppression freed,
Her subjects ever plead,
God Save the Queen.

BRITISH RAILWAY ENTERPRISE.

(*Correspondence of* The Canadian Engineer.)

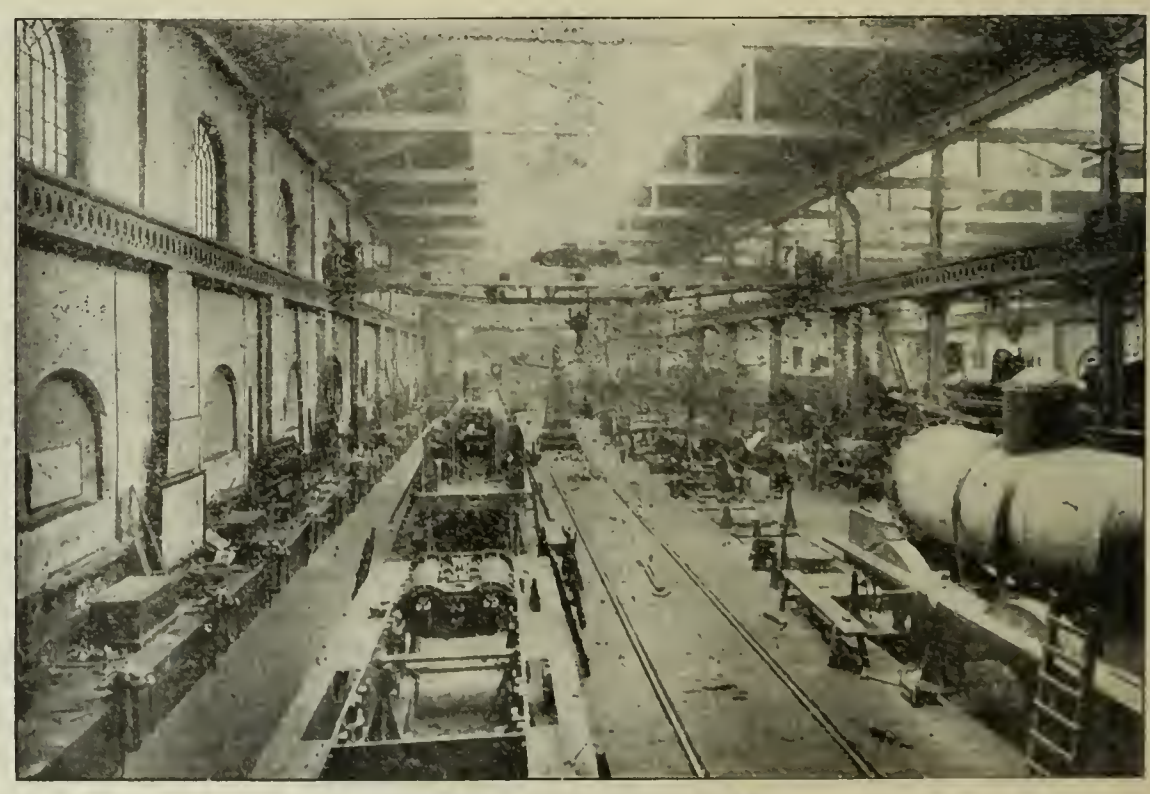
My letter under this head last month made some general comparisons between the railway systems of Great Britain and the United States, and showed that in the great essentials of safety of passengers, speed and economical administration, as well as profits to investors, the railways of Great Britain take the lead.



RAIL MILL, CREWE WORKS.

This, my concluding letter, will give some more concrete facts concerning the magnitude of the operations of a great British railway. In doing this I have singled out the London and North-Western Railway, not only because it is the largest railway corporation in the world, but because it is one of the best administered, and withal most popular with Canadian and American visitors to England. I gave incidentally some figures showing the splendid equipment of this road, and the admirable training of its officers and men, as shown in their ability to handle such enormous crowds of passengers and quantities of freight as they are called upon at times to transport. Figures are not always dry, and certainly the figures with which one is required to deal in describing the work of a great corporation like this, are eloquent in themselves. The capital of the London and North-Western Railway is a little over $600,000,000, the magnitude of which will be realized when I mention that the total capital invested in all the industries of Canada of whatever kind is, according to the census of 1891, $354,620,750. The report of the company for the half year ending June, 1896, shows that the following passengers were carried: First class, 981,785; second class, 1,461,405; third class, 33,416,013; season tickets, 41,815, or at the rate of nearly 72,000,000 per year, and so far as I know not a single passenger's life was lost. This total more than equals the population of the United States, Canada and Newfoundland combined. In one week last year (that before the Bank holiday) the passenger traffic receipts were $1,560,000. And yet the total mileage of the London and North-Western, including leased lines, is only 1,912. The return of rolling stock at the meeting referred to showed 2,335 engines, 1,778 tenders, 4,369 passenger cars or "coaches" of various classes, and 65,850 cars for various classes of freight. This is exclusive of "duplicate working stock," among which are 445 engines. The company also own 4,078 horses—enough to make a strong cavalry force for an army, while its human employes, numbering 60,000, would certainly make a respectable army. The bill for coal and coke for the locomotive department for the past year was $1,975,000, and for "oil, tallow and other stores," for the same branch, $131,740. It requires $12,500 a day to keep the road in proper repair, the approach roads, bridges, signals and like items costing $700,000, and $500,000 a year goes in painting and repairing, besides $150,000 in rebuilding. Over $360,000 a year is spent for new ballasting alone. Every foot of the line is inspected every day, and every signal cabin along the whole system receives inspection each fortnight. In the signal department there are eleven inspectors with 500 foremen, "chargemen," and artisans, and the rodding they deal with would extend from Land's End to John O'Groats, and the wires would more than stretch across the Atlantic from Liverpool to New York. There are 18,000 signals and 1,500 signal cabins, there being nine complete cabins turned out each week at the works at Crewe, to replace worn out ones, some of them having twenty-four arms.

To keep the rolling stock of the London and North-Western in repair costs about $1,500,000. A third class passenger car costs in England about $3,000, and a first class composite one about $4,000, and each vehicle gets sixteen coats of paint before it is finished.



ERECTING SHOP, CREWE WORKS.

So much of the work of car building is done by machinery that the item of labor only costs $100 per car. The car works are at Wolverton, and employ 3,500 men; the goods trucks, or open freight cars, are built at Earlestown, near Liverpool, and employ 2,000

hands, and the cost of maintaining the rolling stock—exclusive of engines—is $2,100,000 a year.

The locomotive shops of the London and North-Western are at Crewe, and to the mechanical mind this is the centre of attraction of the system. It is marvellous to think of a town of this size being solely the creation of a railway company, and fulfilling the needs of only one department of it at that. On the 4th July, 1837 (the year the Queen came to the throne), the first train passed through Crewe, then a hamlet of 148 souls; now it is what Canadians would call a "city" of over 30,000, the whole population depending on or working in the shops of this railway. In 1843 the shops occupied less than three acres of ground, and employed 161 hands; now they cover over 120 acres and employ over 7,000. The town has a Mechanics' Institute, built and maintained by the company, and connected with it is a Science and Art School, whose students have won more Whitworth scholarships than any other place in England. It has a volunteer engineer corps, 600 strong, composed entirely of men in the works. The shops have their own fire brigade, and similar organizations, all very efficiently maintained. The parliamentary division is now named after the town, which contains more than half the electorate.*

EIGHT-TON STEAM HAMMER, CREWE WORKS.

The first locomotive superintendent at Crewe was F. Trevithick, son of the great Trevithick, who, in 1805, brought out his wonderful "steam coach" and exhibited it on the very site now occupied by Euston station, the London and North-Western's London headquarters. In Trevithick's time the company had only 75 engines in stock.

At the Crewe shops, which now employ over 7,000 men, the company makes its own steel, has seven furnaces for steel of the Siemens-Martin process. The London and North-Western is the only English company that rolls its own rails, and a view of one of the rail mills is shown in one of the illustrations. The plant has a capacity of 45,000 tons of rail per year, and actually produces about 30,000 tons. The mill is driven by a 700 h.p. Corliss engine. An ingot of steel 3 feet long and 10½ inches square is taken out of the furnace and fed to the jaws of the swiftly revolving rollers of the mill. The ingot in passing to and fro in these grooves becomes longer and thinner with each squeeze; and finally, when it is formed into rail shape in the last pair of rollers, it is carried on smaller rollers to a circular saw, where the ends are cut off as easily as a scantling of wood is sawn off in a lumber mill, and we behold a finished rail 30 feet long and weighing 90 lbs. to the yard, the whole process of making the rail occupying only a minute. "Within the works," writes W. J. Gordon in an article on this town in *Pearson's Magazine*, "there are five miles and more of the pigmy track of 18-inch gauge which covers the floor of its shops like a spider's web, on which run the miniature engines that once replaced the horses on the Shropshire Union Canal. Anything in the metal way used in railway practice you can get at Crewe from start to finish. You can see the steel made in the converters with all their roaring pyrotechny, and you can follow it from point to point, until it moves off by itself on the rails (made from the same converter), and flies north or south on its trial trip at 50, 60, 70, aye, 80 miles an hour." To build an engine in the ordinary way takes four weeks, but one engine was built here in the space of 25½ hours. The process of erecting an English engine is as follows: The different parts, such as boilers, frame plates, cylinders, axles, etc., being previously made in their respective shops, are brought here to the erecting shops, where first the frame plates are fixed by temporary cross-bars into the place they will occupy when the engine is complete. The cylinders and foot plate are then fixed in position, and when the skeleton is complete the boiler is

BOILER SHOP, CREWE WORKS.

lifted on by a crane. Then the cylinders are fitted in, and the wheels (which are usually of cast steel, and to which the axles have already been fitted) are then run under and the frame lowered down on them. The

*For a fuller description of Crewe and its shops see article in *English Illustrated Magazine*, Feb., 1892, by C. J. B. Cooke.

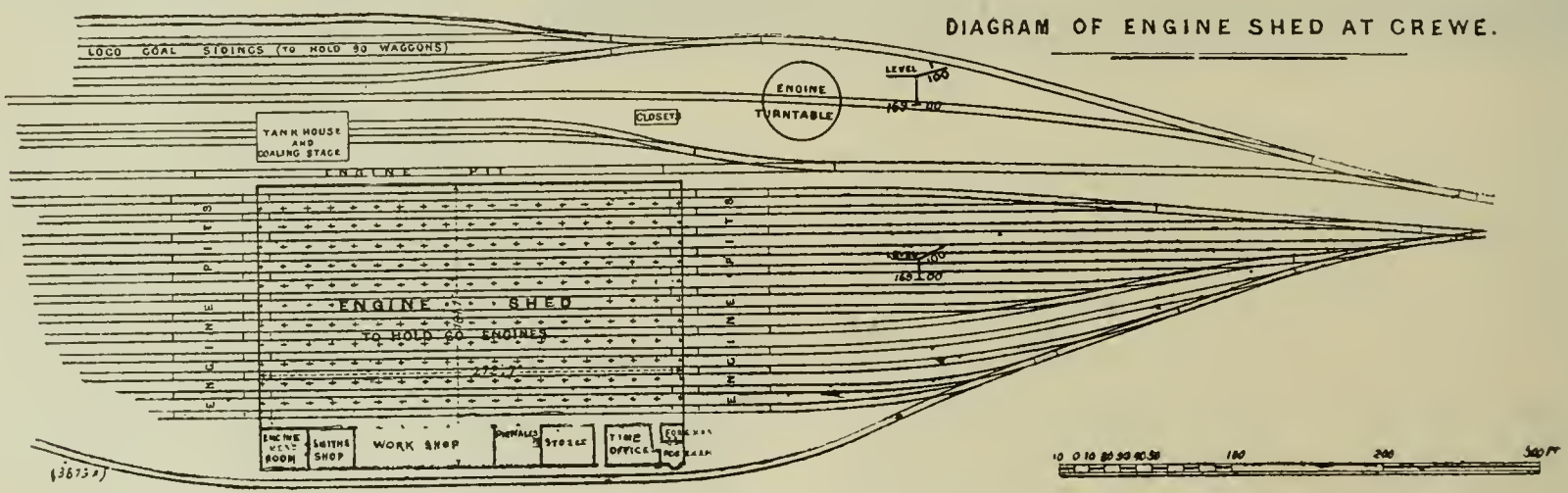
next work is the connecting of the rods and all the intricacies of the valve motion, and then all the internal and external fittings are completed. Before she is taken to the paint shop and polished up, she is sent out on her trial trip. As mentioned before, over 2,000 engines pass through these shops each year for overhauling and repair, and all the engines of the line consume about 3,500 tons of coal per day.

In the wheel shop some very fine machine tools are to be seen. Some of the lathes are capable of turning a wheel nine feet in diameter. One machine called a "roughing lathe," has seven tools all employed at once in taking a rough cut off the crank axle, tearing the steel away in huge bites and making the axle ready for the finishing tool. A "nibbling machine," with 160 cutting tools, eats its way into the solid forging of a crank and cuts out the "throw" or inner bend of the crank. The boiler shops, a view of which is here given, employ several hundred hands, and the noise of riveting is like the roar of a tropical hail storm.

A new engine shed has just been completed, after a design by F. Webb, the able superintendent, to hold 60 standard tender engines. It is a "through and through" shed, and will be used principally for the "turnback" engines arriving at Crewe with goods trains from either the north or south. These will pass into the shed at one end as they come off work, and

It pays over $57,500 a year in light and harbor dues; its steamboat repairs cost over $75,000 a year; its marine coal bill is over $90,000 a year, and the manning of its fleet costs $215,000 a year. Altogether it spends a trifle under five hundred thousand a year on its steamers. And its canals at Lancaster and Huddersfield cost over $35,000 a year. During the same period it paid the Government $75,000 as passenger duty, and its rates and taxes reached the enormous total of over $750,000. Its telegraphing costs $285,000 a year. To its superannuation fund, insurance, provident and pension societies and schools it gives $225,000 a year. Curiously enough, it has among its directors one that is hereditary, as the Great Western has one in Sir Watkin Wynn. This is the Duke of Sutherland, whose father is still known in railway circles as "the real live duke," from an incident which occurred on a line contrasting very decidedly with the North-Western, being that in Sutherlandshire, in the Dunrobin and Helmsdale country, which his Grace practically paid for out of his own pocket. One day he was driving the express on this line as the train passed two navvies. 'There Bill,' said one of them, 'that's what I calls a real live dook; he's a-driving his own engine on his own line, and burning his own blessed coals!' He would be a rich man of whom that could be said on the North-Western."

DIAGRAM OF ENGINE SHED AT CREWE.



after cleaning, will come out at the other end for the return journey. The length is 272 feet 7 inches, whilst the breadth is 184 feet 1 inch. All the ironwork is made to template and to standard patterns, so that any part will fit any similar shed, many of smaller dimensions having been erected at different points of the company's lines. The arrangement of tracks is shown in the diagram, which is reproduced from *Engineering*, of London.

To finish with a few more general statistics. The wages bill of the traffic department of the London and North-Western is $8,455,000 a year; over $1,000,000 a year is spent in fuel and light for the waiting rooms and cars; the uniforms for the men cost $150,000 a year, and the printing and stationery amounts to over $300,000, the actual weight of tickets sold being about 70 tons a year. The passenger trains run over twenty-one million miles a year, and the goods trains (freight) nearly as many, making a total of forty-one million miles. The receipts from passengers and freight make an annual total of over $32,500,000, and the total weight of passengers and freight thus carried is estimated at 38,000,000 tons.

But, as Mr. Gordon says in the article previously quoted, "there is a North-Western afloat as well as a North-Western ashore; the company is not only a railroad owner, but a canal owner and a steamboat owner.

For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C. E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

ARTICLE III.—TRAFFIC.

Wellington demonstrates that the traffic revenue increases with the (*population per mile of railway*)^2.

This is based on the rough assumption that the volume of traffic increases as the distance between two towns diminishes, or that the gross traffic receipts between two towns is nearly a constant, and thus if on a given line we have two traffic points and call traffic 1. Then with three traffic points the traffic $= 1 + 2$, and with n traffic points the traffic $= n\frac{(n-1)}{2}$, or when n is large we may neglect the second term and say that the traffic for n points $= \frac{n^2}{2}$. Now if we apply this to the individual as a unit, we may deduce the general statement given above. This assumption is not tenable when applied to a special commodity which originates at a fixed place, such as coal. Because the traffic is the same for two towns 150 miles or 15 miles from the coal pit, depending entirely on the demand for coal, on the other

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

hand it is augmented by the fact that short haul rates are usually higher than long haul for the same service. Even this consideration, however, will not hold at the present day for suburban steam traffic, because it is being terribly crippled by electric suburban railways. On the whole, it is probably still true for a road of considerable length of general traffic, not largely suburban.

This view is upheld by the following table of the internal traffic of New York city:

Year.	Population.	Trips per year per inhabitant.	Value by $(n)^2$ Formula
1860	814,000	45	45
1870	942,000	122	60
1880	1,206,000	175	99
1885	1,393,000	213	132

By which we see that the gross returns exceeded the ratio of $(population)^2$, but as the length of haul also increased it is probable that the net revenue about followed the law given. The following table, also, of a broader and more general character, confirms the view given:—

TABLE I.

SHOWING INCREASE OF POPULATION AND RAILWAY EARNINGS IN UNITED STATES AND CANADA, 1870 TO 1895.

	Year.	Miles of Railway.	Gross Earnings ÷ 10,000	Population ÷ 100,00	(Col. iv.)^2	Rates of Col. iii. Col. v.
Canada.	1875	4,300	$1,958	39	1,521	1.29
	1880	6,800	2 355	43.	1,849	1.27
	1885	10,200	3 223	45.	2,025	1.59
	1890	13,100	4,680	48.	2,304	2.03
	1895	16,091	4,680	51.	2,601	1 79
U.S.A.	1870	54,000	37,000	385	148,225	.249
	1875	74,000	50,000	440	193,600	.258
	1880	94,000	60,000	501	251,000	.239
	1885	128,000	77,000	565	319,225	.241
	1890	166,000	120,000	626	391,876	.307
	1895	180,000	107,500	690	476,100	.225

This table shows (assuming that the population served per mile of railway increases in the same proportion as the population of the country as a whole does) that the gross earnings, both in Canada and the United States, have increased more rapidly than the $(population)^2$; however, the rapid falling off from 1890 to 1895 in both countries suggests that this may not entirely hold true in the future.

As another indication of the same law, compare Canada and United States for 1895. (See Table II.)

	Gross Earnings per Mile.	(Pop. per mile of Railway)^2
Canada	$2,908	$(317)^2 = 100,489$
U.S.A.	5,945	$(382)^2 = 145,924$

Which shows that the gross returns per mile of railway are even more than in the proportion of "square of population per mile of railway."

In any given case it will be difficult to estimate the actual tributary population, which may be decreased by competition, increased by feeders or affected by industrial conditions, but if applied on a large scale to eliminate irregularities, we may look on it as quite accurate enough to guide us in comparisons of routes. Thus, supposing a railway by altering its general location can be made to serve 1,200,000 people instead of 1,000,000, we may estimate its gross returns to be increased from 100 to 144, or 44 per cent., while if the road is not materially longer, or poorer physically, the increase in operating expenses will be much less in proportion.

Revenue is often considered to be injured by a long line between terminals, but this is, largely, a mistaken idea; the only case in which it is true is when there is keen competition between two places, by two or more routes, in which case the rate is fixed by the shorter line, but in non-competitive and local traffic, or even in the case of a road forming one link in a trunk line, rates are fixed by the mile or divided on a mileage basis, so that if a road can be located through more populous districts, built cheaper or with lighter grades, then the advantages of higher traffic charges, greater volume of traffic, less working expenses and fixed charges may any or all be in favor of the longer line. Incidentally, in Canada bonuses are often given on a mileage basis. These remarks apply only to moderate increases in length of line of from 5 to 10 per cent.

The folly of long tangents, creating more first cost, and often missing local traffic points, is a blunder somewhat common; the idea of serving the public by passing through the *very heart* of each populous district should be more fully appreciated, for ultimately, whatever traffic a road may have is from door to door, including cartage and bus fares; most evidently is this so at competing points. But the most important effect is that a good railway service convenient to the public will foster and increase traffic, while a town given the go-by for the sake of saving a little in land damages, or distance, has often had its prospects blighted forever; it is most important that a road should establish large roomy depots and obtain plenty of yard room while land is inexpensive, in anticipation of future growth on the part of any prosperous town. Wellington estimates the loss of traffic for each mile a depot is distant from the centre of population at from 10 per cent. to 25 per cent., being greatest at competing points and in manufacturing towns.

TRUNK LINES.

Most trunk lines are liable to suffer from competition, and, to protect themselves, buy or build feeders, and this has concentrated railways into large systems, but a general rule is to link together the largest possible population, quite regardless of minor losses in distance. The limit should never be approached when the increase in revenue is no greater than the increase in length of line, or when differences of distance are so great as to discourage traffic or encourage the construction of a competing road, and an exception might also be made in the case of being able to pass midway between two towns and serve them fairly well by branches.

The N.Y.C. & H.R.R. is a striking example of a road much longer than any of its competitors, but with light grades and a heavy tributary population, it is largely independent of its through traffic, and can handle it as "excess traffic" at a very low rate; on the other hand, the Pennsylvania R.R., soon after its completion west, built feeders in every direction, and thus held traffic that would otherwise soon have passed into other hands owing to its heavy grades.

Other general conclusions regarding trunk lines are:

(1) That they should never attempt to make a small sea or lake port a terminal, but have the largest possible terminals even at the expense of considerable extra distance. As instances of this, witness the Intercolonial making arrangements to enter Montreal, the Erie Railway abandoning Dunkirk as a terminal and building into Buffalo, and the Mexican National attempting to establish a port at Corpus Christi, instead of Galveston, which proved a failure.

TABLE II.—RAILWAY STATISTICS, 1895.

CAPITALIZATION, FIXED CHARGES, WORKING EXPENSES, EARNINGS, ETC.

Item.	Canada.		Great Britain.		United States.	
	Total.	Per Mile.	Total.	Per Mile.	Total.	Per Mile.
Mileage	16,091	.....	21,174	.....	180,657	§
Population	5,100,000	317	39,300,000	1,856	69,000,000	¶ 382
Square miles	1,609,000	.....	120,800	.....	2,970,000	¶
Population per square mile	3.2	.....	325	.....	23.2	.....
Capitalization.						
Bonds	$330,786,000	$20,557	$1,800,906,000	$85,000	$5,407,000,000	$30,000
Preferred stock	105,680,000	6,568	1,236,446,000	58,400	759,000,000	4,200
Common stock	255,769,000	15,897	1,772,862,000	83,700	4,961,000,000	27,400
Loans and floating debts	37,626,000	2,338	67,196,000	3,100	616,000,000	3,500
Bonus and Government aid	167,523,000	10,411	.....	.....	.....	.....
Total	$897,384,000	$55,761	$4,875,410,000	$230,200	$11 743,000,000	‖$65,100
Earnings, Etc.						
Passenger	13,311,440	827	181,949,000	8,593	252,000,000	1,390
Freight	29,545,490	1,836	214,450,000	10,033	730,000,000	4,040
Other	3,928,560	245	22,044,000	1,136	93,000,000	515
Total	$46,785,490	$2,908	$418,443,000	$19,762	$1,075,000,000	$5,945
Working expenses	32,749,670	2,035	233.159,000	11,011	726,000,000	4.020
Net earnings	$14,035,820	$873	$185,284,000	$8,751	$349,000,000	$1,925
Per cent working expenses to gross earnings	.70	.....	55¾	.....	67½	.....
Per cent. net earnings to total capitalization	1.56	.....	3.80	.....	2.97	.....
Fixed Charges.						
Bond interest	*$15,287,250	(4 62%)	‡$121,494,000	(4%)	$240,000,000	(4.42%)
Other interest on loans, rentals, etc.	†1,881,300	(5 0%)	‡ 2 688,000	(4%)	53 000,000	.....
Total	$17,168,550	.....	$124,182,000	.....	$293,000,000	.....
Net income	— 3,132,730	.....	61,104,000	.....	56,000,000	.....
Stock-bearing dividends	.....	.....	1,538,920,000	.....	1,716,000,000	.....
" not "	.....	.....	233,760,000	.....	3,245,000,000	.....
Dividends declared	.....	.....	61,104,000	.....	85.000,000	.....
Taken from surplus, or borrowed	.....	.....	.....	.....	29,000,000	.....
Passenger charge per mile	Estimated 2·5c.	.....	2.1c.	.....	2.07c.	.....
" per ton-mile	" 1¼c.	.....	2.0c.	.....	.84c.	.....
Earnings per passenger train-mile	87c.	.....	99c.	.....	77c.	.....
" " freight "	$1.48	.....	$1.43	.....	$1.49	.....
Average cost per train mile	80½c.	.....	64⅔	.....	87c.	.....

* Includes 4½ per cent. on $14,212,000 bonds of which rate of interest is not obtainable. † Estimated at [illegible] per cent. ‡ Estimated at 4 per cent. on bonds and preferred stock. § Not including extra tracks. ¶ Only explored regions of Canada are counted in this calculation. ‖ U.S. stock heavily watered.

TABLE III.—RAILWAY STATISTICS, 1895.

TRAFFIC, EQUIPMENT, ETC.

Item.	Canada.		Great Britain.		United States.	
	Total.	Per Mile.	Total.	Per Mile.	Total.	Per Mile.
Gross earnings per inhabitant	$9 00	.....	$10 60	.....	$15 60	
Passenger Traffic.						
Number of passengers	13,987,580	870	930,967,000	43,900	543,000,000	3,066
Passenger cars	1,994	1.2/100	42,230	2.	33,112	1.8/100
Average haul (miles)	38*	.....	8	.....	23	
Average load	35*	.....	49	.....	39	
Passenger cars per 1,000,000 passengers	143	.....	45	.....	65.	
Passenger train miles	15,332,276	.....	184,200,000	.....	327,294,000	
Passenger trains per day (each way)†	1¼	.....	12	.....	2½	
Freight Traffic.						
Tons of freight	21,524,421	1,340	334,230,000	15,800	763,000,000	4,230.
Freight cars	52,118	.....	603,710	.....	1,196,119	
Average haul (miles)	110*	.....	35	.....	116.	
Average load (tons)	119*	.....	73	.....	180.	
Freight cars per 1,000,000 tons	2,421	.....	1,806	.....	1,717	
Freight train miles	19,939,699	.....	150,400,000	.....	491,410,000	
Freight trains per day (each way)†	1 7/100	.....	9 7/100	.....	3 7/100	
Mixed Traffic.						
Various kinds of cars‖	5,999	.....	31,088	.....	41,330	
Mixed train mileage	5,389,915	.....	4,300,000	.....	15,457,000	
Mixed trains per day (each way)†	½	.....	3/100	.....	1/8	
Total trains per day (each way)†	3 46/100	.....	22	.....	6 33/100	
Engines.						
Total number	2,023	.....	18,658	.....	35,111	Including switching engines.
Average yearly engine mileage‡	20,100	.....	18,160	.....	23,760	
Employees	55,000	.....	465,112	22.	785,000	41 4/100
" killed	50	.....	442	.....	1,811	
" injured	488	.....	2,654	.....	25,693	
Passengers killed	9	.....	83	.....	170	
" injured	60	.....	1,109	.....	2,373.	
" killed, 1 in	1,554,000	.....	11,202,059	.....	2,984,000	
" injured, 1 in	233,126	.....	838,387	.....	213,000	

* Based on assumed average passenger and freight rates. † 365 days in a year. Train each way called "one train per day."
‡ Including switching engines. ‖ Express, Baggage, Postal, Sleepers, Dining Room, Transportation Co.'s Cars, etc.

(2) That after joining together as large a population as possible without unduly lengthening their line, they should build or buy such a system of branches, as feeders, as will draw to the main line as large a volume of traffic as possible, even in the face of competition. No better example of this can be given than in the Province of Ontario, where the G.T.R. and C.P.R. both endeavor to have feeders in all directions, and fight each other in many towns. Almost all the independent small lines of that Province have disappeared.

Branch Lines.—Branch lines are usually unprofitable in themselves, *e.g.*, Midland Railway of Canada, a network of short lines operated by the G.T.R. at a yearly loss, for the purpose of securing a large volume of freight for its main line, and preventing the C.P.R. from getting it. This is the reason, in almost all cases, which causes the most prosperous roads to operate them, to swell the trunk line traffic, because once any branch line traffic is delivered to the main line, it being *extra* traffic, is very profitable, often costing almost zero to handle, while the toll collected is for the whole trip. Putting the cost of handling the unit of minimum traffic on a main line at 100, the cost of handling a single extra passenger or small parcel of freight is almost zero: in car load lots at 10 to 30 per unit, and in train load lots at about 50 per unit.

A branch line, however, usually costs nearly as much per mile to build as a main line, and nearly as much to maintain—certainly far more than in proportion to the traffic; so that we can usually lay down a rule of branch line location to make it strike the main line as soon as possible, but meet it at a town if possible in order to give the branch more return freight; country junctions of branches are deadly in their lack of traffic (other things being equal), therefore branch lines should rather be numerous and at right angles, or nearly so, to the main line, than to run parallel to the main line for any great distance, stringing together unimportant hamlets before joining the main stem.

Volume of Traffic.—The volume of traffic by Table III. is shown to be about $9 per head, per year, in Canada, and $15.60 per head, per year, for the United States. We may not assume, however, that it is uniform in Canada; but varies probably as rapidly as the square of the density of tributary population. The average town would probably be about $10 per year, per head, increasing to very much more for large towns and cities. The class of town also has a great effect; an industrial town such as Galt, Ontario, would afford far more traffic per head than such a town as Whitby or Cobourg, owing to the pursuits of the inhabitants being different. The great volume of suburban traffic cannot be counted on in the future, as the cheap roadbed, etc., few restrictions, frequent service, and convenient depositing of passengers, enables electric lines to serve such a traffic very successfully. This is a serious problem for steam roads to face, as suburban traffic has been, in the past, a very profitable feature to many roads.

INCREASE OF TRAFFIC.

cent. which operating expenses bears to enue varies enormously. Roughly speak- l which economizes in its investment, on ys interest, is apt to have heavy operating This percentage in Canada varies from 256 to 43 per cent., with an average of 70 per Canada in 1895.

These working expenses may be roughly divided as follows:—

(1) Maintenance of line and buildings	15	70
(2) Working and repairs of engines	22	
(3) " " cars	6	
(4) General expenses	27	

Now careful estimates show that only about half of these expenses are increased by an increase of traffic beyond a meagre minimum, which is the reason why it is so important to select a route giving the most traffic, as it is the *increase* of traffic over that which gives profit enough to pay fixed charges, to which we must look for profit to the stockholders, and a very moderate difference in first cost, revenue or working expenses means success or failure.

In any young country like Canada traffic increases rapidly at first, the increase being twofold: (1) A natural increase due to increased population; (2) An increase fostered by the newly discovered wants of a people not before served by a railway, the critical period of a road's history being usually the first few years of its existence, before a solid, steady revenue has been secured.

In England, New England States or Eastern Canada, the growth of traffic may be estimated at 5 to 6 per cent. per year for a given line. While in Western America or any new country, 10 to 15 per cent. per year will not be too much to figure on. The usual way of estimating traffic is by the number of trains per day over roads of certain maximum grades; but on roads of small traffic, which do not wish to run less than one train per day each of freight and passengers, the trains are not apt to be loaded well, and again two trains per day will be considered necessary to accommodate the people long before they will be regularly filled, so that it is only on roads of heavy traffic that it can be divided into the number of trains that will just accommodate it.

ARTICLE IV.—RECEIPTS.

Referring to Table II., "Railway Statistics," it will be seen that American freight charges are lower than English with a less volume of traffic. This anomaly is explained by the frequent, lightly-loaded freight trains of England run at a high speed, with small cars and heavy terminal charges. An adoption of heavy American cars, larger trainloads, and a slightly decreased speed, with perhaps five freight trains per day instead of ten, would enable English freight rates to be lowered more than one-half, and effect an enormous economy. Partly due to high rates on freight, but chiefly due to enormous traffic, the receipts on English roads are nearly $20,000 per mile per year, as against $5,900 per mile per year in the U.S.A, and $2,908 per year per mile in Canada; operations for 1895 showed net earnings to be 3.8 per cent. interest on gross capitalization of English roads, as compared with 2.97 per cent. per year in the U.S.A., and 1.56 per cent. per year in Canada.

This great difference, in spite of the capitalizations of the railways, per mile of railway, being $230,000 for Great Britain, $65,000 for U.S.A., and $55,760 for Canada, is due to two distinct causes, (1) volume of traffic, (2) decreased percentage of operating expenses to gross earnings due to this increased traffic, the net earnings being $8,751 per mile for England, $1,925 for U.S.A., and $873 for Canada. Let us now discuss that to position which Canadian railways occupy fi- handed which first taking Canadian railways as a whole application and classifying them: to that of a promi-

ARTICLE V.—CANADIAN RAILWAYS.

The returns for 1895 are about as poor as could be selected, and those just handed down for 1896 show a slight improvement, but this may be due to temporary retrenchments, which have to be made up for sooner or later, such as track and car economies, by letting the condition run down slightly. The net earnings of Canadian railways of $873 per mile give net receipts of $14,035,820, but the interest on bonded debts, and estimated amount of loans, etc., amounts to $17,168,000* (approx.), or a net loss of over $3,130,000, and nothing with which to pay interest on the $167,000,000 that the various Governments have given either in the form of an investment in Government railways or as bonuses, and nothing with which to pay dividends on stock. This does not look encouraging; competition and popular clamor keep rates down to the lowest possible notch, and so long as our traffic is small it seems certain that, considering the severe climatic conditions under which our roads are operated, and the evident economy of management (70 per cent. of gross receipts as compared with 67½ for U.S.A.), the present rates must be fully maintained, if not raised. The stock of Canadian railways is not all real, but estimating that one-half is real and one-half water, we have $180,000,000 invested bearing no interest, besides the $167,000,000 which the people of the country have sunk in them in order to have sufficient railway accommodation. Even neglecting interest on all loans, floating debt, etc., there is still a deficit on bond interest of $1,252,000, which is met year by year by issues of more bonds and stock, or by creating floating debts which are periodically so converted; we go on year by year mortgaging futurity. It is hoped that in a few more years increased traffic will enable the bond interest to be fully met, and in this the increased solidity of permanent way will greatly aid. The average cost per train mile is very low (80½c.), considering our high price of coal, severe climate, rather inferior road beds, small number of trains per day, and good wages paid; it reflects great credit on Canadian management as a whole.

Let us now analyze Canadian workings by dividing the roads into four groups. (See Table IV).

(1) *Canadian Pacific Railway System.*—This road shows a low bonded debt, moderate stock, and high Government aid per mile (much of this latter, however, being tied up yet as land grant); on this account, and because it can charge higher rates in the west, it is enabled to keep its net earnings large enough to pay bond interest, and on prosperous years has considerable left over to pay dividends on stock. If dividends were declared in 1895, they were drawn quite justifiably from the surplus; but on the whole, the C.P. Railway by a very efficient management, high train-mile earnings ($1.45), and low first cost, is by far the most prosperous of Canadian railways, in spite of such low gross earnings as less than $3,000 per mile. The future increase of traffic in the North-West will enable it to lower its rates and still make a profit; but for the present, it is hardly clear how this can be done. The C. P. Railway also has the advantage of new equipment which does not need such heavy repairs. It is gradually improving its road-bed by the construction of masonry and ' in place of wooden structures.

Passengers k..
" injur? the assumption in Table II. that the interest on loans,
" killed,5 per cent.; probably a large proportion of it bears no
" injured,

* Based on assumed ..
† Including switching ..

TABLE IV.—ANALYSIS OF WORKINGS OF CANADIAN RAILWAYS FOR 1895.

CANADIAN PACIFIC RAILWAY SYSTEM.

	Main Line. Total.	Main Line. Per mile.	Branches. Total	Branches. Per mile.	Total. Total.	Total. Per mile.
Miles	3,575	.....	2,709	.....	6,284	.....
Capitalization—						
Bonds	$98,923,000	$27,700	$47,027,000	$17,300	$145,950,000	$23,200
Preferred stock	6,424,000	1,800	3,585,000	1,300	10,009,000	1,600
Common stock	65,000,000	18,200	12,410,000	4,600	77,410,000	12,300
Loans and floating, etc	1,948,000	500	3,445,000	1,300	5,393,000	900
Bonus and Government aid	58,996,000	16,500	17,454,000	6,400	76,451,000	12,200
Total	$231,291,000	$64,700	$83,921,000	$30,900	$315,213,000	$50,200
Interest on bonds	4,122,000	.....	2,285,000	.....	6,407,000	.....
Interest on loans and floating, etc	97,000	.....	173,000	.....	270,000	.....
Apparent total fixed charge	$4,219,000	$1,180	$2,458,000	$900	$ 6,677,000	$1,060
Gross earnings	.....	.....	.....	.....	17,962,000	2,860
Working expenses	.....	.....	.....	.....	11,317,000	1,800
Net earnings	.....	.....	.....	.....	+$6,645,000	$1,060
Per cent. of working expenses to gross earnings	.....	.....	.....	.....	63	
Apparent net income	.....	.....	.....	.....	— 32,000	.....
Train mileage	.....	.....	.....	.....	12,319,500	.....
Average trains per day	.....	.....	.....	.....	23	.....
Earnings per train mile	.....	.....	.....	.....	$1 45	.....
Cost of train mile	.....	.....	.....	.....	91	.....
Operating expenses—						
Maintenance	.....	.....	.....	.....	15½	.....
Working and repair of engines	.....	.....	.....	.....	19 } 63	.....
Working and repair of cars	.....	.....	.....	.....	4	.....
General expenses	.....	.....	.....	.....	24½	.....

GRAND TRUNK RAILWAY SYSTEM.

	Main Line. Total.	Main Line. Per mile.	Branches. Total.	Branches. Per mile.	Total. Total.	Total. Per mile.
Miles	884	.....	2,280	.....	3,164	.....
Capitalization—						
Bonds	$ 75,243,000	$ 85,100	$33,649,000	$14,800	$108,892,000	$34,400
Preferred stock	89,244,000	100,900	2,556,000	1,100	91,800,000	29,000
Common stock	109,383,000	123,700	50,000	.....	109,433,000	34,600
Loans and floating, etc	15,143,000	17,100	76,000	.....	15,219,000	4,800
Bonus and Government aid	.....	.....	10,301,000	4,500	10,301,000	3,300
Total	$289,013,000	$326,800	$46,632,000	$20,400	$335,645,000	$106,100
Interest on bonds	3,385,000	.....	1,535,000	.....	4,921,000	.....
Interest on loans and floating, etc	757,000	.....	4,000	.....	761,000	.....
Apparent total fixed charge	$4,143,000	$4,690	$1,539,000	$680	$ 5,683,000	$1,800
Gross earnings	.....	.....	.....	.....	16,091,000	5,090
Working expenses	.....	.....	.....	.....	11,094,000	3,510
Net earnings	.....	.....	.....	.....	+$4,997,000	$1,580
Per cent. of working expenses to gross earnings	.....	.....	.....	.....	63	.....
Apparent net income	.....	.....	.....	.....	—685,000	.....
Train mileage	.....	.....	.....	.....	15,381,200	.....
Average trains per day	.....	.....	.....	.....	63	.....
Earnings per train mile	.....	.....	.....	.....	$1 05	.....
Cost of train mile	.....	.....	.....	.....	72c.	.....
Per cent. of working expenses to gross earnings	.....	.....	.....	.....	111½	.....
Apparent net income	.....	.....	.....	.....	24 } 69	.....
Train mileage	.....	.....	.....	.....	7	.....
Average trains per day	.....	.....	.....	.....	26½	.....

	Dominion Government Railways. Total.	Dominion Government Railways. Per mile.	Remaining Railways of Canada. Total.	Remaining Railways of Canada. Per mile.
Miles	1,382	.....	5,261	.....
Capitalization—				
Bonds	.....	.....	$75,944,000	$14,400
Preferred stock	.....	.....	3,871,000	700
Common stock	.....	.....	68,926,000	13,100
Loans and floating, etc	.....	.....	17,014,000	3,200
Bonus and Government aid	$58,759,000	$42,500	22,012,000	4,200
Total	$58,759,000	$42,500	$187,767,000	$35,600
Interest on bonds	.....	.....	3,95 ,000	.....
Interest on loans and floating, etc	.....	.....	851,000	.....
Apparent total fixed charge	.....	.....	$4,810,000	$910
Gross earnings	.....	.....	9,642,000	1,830
Working expenses	$3,090,000	$ 2,240	7,168,000	1,370
Net earnings	— $80,000	.....	+$2,474,000	$460
Per cent. of working expenses to gross earnings	.....	.....	74	.....
Apparent net income	103	.....	— 2,336,000	.....
Train mileage	—80,000	.....	8,732,000	.....
Average trains per day	4,230,000	.....	24	.....
Earnings per train mile	4 1-5	.....	$1 10	.....
Cost of train mile	73c.	.....	82c.	.....
Per cent. of working expenses to gross earnings	75c.	.....	.....	.....
Apparent net income	.....	.....	.....	.....
Train mileage	.....	.....	.....	.....
Average trains per day	.....	.....	.....	.....
Earnings per train mile	.....	.....	.....	.....
Cost of train mile	.....	.....	.....	.....
Per cent. of working expenses to gross earnings	25	.....	.....	.....
Apparent net income	36	.....	.....	.....
Train mileage	14 } 103	.....	.....	.....
Average trains per day	28	.....	.....	.....

It is noticeable that the cost per mile of the main line, $64,000, is not as high as the average of U.S.A. railways, and the route is very rugged, while the branches containing many first-class roads in Ontario and elsewhere have only cost $30,900 per mile, and very little, if any, has been charged against the main line, as in the Grand Trunk system.

(2) *Grand Trunk Railway System.*—The main line, built in early days when wages and material were high, built too solidly for its traffic, built in disregard of what is now known to be the true principles of railway location, and since then, burdened still further to pay bond interest and buy branches, is loaded with an enormous debt. The branches were often injudiciously bought, or bought to protect its traffic at a sacrifice, and do not pay. Taking the road as a whole, it is loaded with a heavy debt; suffers from keen competition, not only from Canadian, but U. S. railways; and by being thus forced to haul at low rates, has never been able to meet its obligations in spite of a traffic of $5,090 per mile, which increases to $6,000 per mile in good years. Its operating expenses are higher, and train earnings lower than they should be, and a more vigorous management with a more careful study of maximum train loads by the tonnage system may effect improvement. This system has been the backbone of Canada; it has received very meagre aid ($3,300 per mile) from governments or municipalities, and the bondholders and owners deserve the highest praise for the integrity of management which has characterized it; a less scrupulous one would have thrown it into a receiver's hands after having plundered it for a few years. This has been done in America very often, with a severe loss to British bondholders. It is noticeable that the branches have been bought, largely, by mortgaging the main line; it is impossible to arrive at the cost of each.

(3) *Dominion Government Railways.*—These cost as much to operate as the earnings amount to. The cost per mile is a good example of actual cost, there being no inflation of capital. The Intercolonial was well built through a rough country; but could be built to-day for less than $30,000 per mile, owing to less cost of explosives, steel, labor, etc. It seems evident that for the light traffic of $2,240 per mile, there are too many trains per day; $4\frac{1}{5}$ trains per day for 365 days is too much, and although the people on the route might object, the economy of reducing traffic to about three trains per day, say one passenger, one mixed, one freight, would effect a great saving; this is evident by the very small train-mile earning, 72c.

(4) *Remaining Railways of Canada.*—These contain several high class roads, such as Canada Atlantic and Michigan Central; but on the whole, they are those roads which have been built to serve local needs or to develop country; their cost per mile ($35,500 being total capital against them) is small, but traffic still smaller; their earnings are not nearly sufficient to pay fixed charges, and some borrow more each year to pay it, while others default payment. The future of many of them is not reassuring until their traffic increases; but they are, on the other hand, many of them aiding in the development of country that would otherwise be beyond reach.

The need for more railways in Canada, except for some very special reason, is not at present apparent.

THE Rossland, B.C., council will buy at once a chemical engine, hose wagon and hook and ladder truck.

For THE CANADIAN ENGINEER.

TOWNS WATER SUPPLY AND ITS DISTRIBUTION.

BY W. M. WATSON, TORONTO.

The geographical advantages of Canada are superior to those of most countries. There is none where there are such a large number of fine sheets of water of good potable quality, and almost every town and small village could have a plentiful supply of good water, inside each house, at a moderate cost, if the Government would engage engineers and mechanics who have skill and experience, to work out a comprehensive scheme in each district. It is a crime to supply a town with tainted water, or compel those living in villages to depend on wells of doubtful purity, which sometimes run dry when water is most in demand. Abundance of good water in the house convenient for use at will is a sanitary necessity, and it is the duty of the governing body to arrange for and secure a permanent supply at a reasonable expense and charge to the consumer.

When constructing waterworks, care should be taken in arranging and joining the iron street mains and conduits and every other apparatus used for distributing or conveying the water, so that they cannot be injured by frost or dirt, or by the pounding of water hammer caused by sudden concussions of confined air. The joints should be all well and carefully made, and if lead be used, each joint should be run full and solid at one teaming of the ladle, at least to a depth of two inches. Maiden or new pig lead should always be used for jointing. Each joint should have two circles of hemp rope driven well back and tight, for the lead to wedge against. It is the hemp rope that keeps the joint tight; the lead holds it to its place, so it is necessary to have a good quality of rope. Above all else, it is necessary to make proper provision for cleaning out every part of the pipe system, and to prevent waste or leakages, which not only wastes money, but damages the roadbeds and the foundations of property adjoining the line of pipes.

Water suitable for domestic use should be transparent, without smell, taste, or suspended matters, totally free from any excreta or sewage deposits of any kind. Marsh or nullah water, which is loaded with vegetable debris, must be carefully avoided. Water for industrial purposes should be void of minerals, because they increase the cost of soap and scouring materials when used for cleaning purposes, they scale steam boilers and heating pipes, and interfere with the production of colors when dyeing fabrics. The French cloths are always softer to the touch than British, because of the quality of water used in finishing and dyeing, and thousands of pieces of manufactured stuffs are sent over to France from England to be dyed and finished and then returned. Tainted dirty water with a mixture of fine sand would ruin a stuff manufacturer or dyer in a short time. It is advantageous to secure water well ærated, similar to the water at the foot of Niagara Falls, or rain water, which during its fall through the atmosphere secures (according to analysis made by Dr. E. A. Parks, F.R.S.), a large percentage of oxygen.

D. G. F. Gaskins, C.E., when delivering his presidential address before the British Association of Waterworks Engineers at Nottingham last year, stated that to manage a waterworks a knowledge was demanded which could only be obtained by close study, application and practice. This is different teaching to that of a promi-

nent civil engineer, who wrote to me saying that there was no room in Canada for experienced waterworks superintendents, because the colleges were turning out yearly more students than there were such places to fill. If the students fill such positions raw from the colleges, without learning the trade and securing working experience, whatever salary or wages they receive, it is little better than robbery of the ratepayers. A valuable engineer never attempts to construct, or even manage the construction of systems that have been planned and laid out from his own ideas. He keeps his position, and expects the mechanic and manager to faithfully keep his.

Mr. Mansergh, in his fifteen-thousand dollar report on Toronto waterworks, expressed himself in a way that can only be interpreted to mean that he considered the construction and management of all American waterworks systems of a low standard. He attributed the reason to the fact that the city of Toronto had to pump over 100 gallons of water for each inhabitant each day, to waste or misuse—adding the important remark, as in other American cities. (See copy of report in the *Surveyors' Journal.*) The reason why there is a low standard of public works in this country in comparison to the works in the old country, is because there is no proper check placed on the local authorities by the Government. A single ratepayer having a substantial grievance and who can prove that the local authorities are wasting public money, or mismanaging the public business, or allowing the public works to be mismanaged, or voting themselves funds, etc., can petition the English Local Government Board, who will send an expert engineer to make a full inquiry, and if abuse of the trust put in the representatives elected by the popular vote be proved, or it is found that any of the officials are not worthy of the confidence placed in them, he will report the same to the Government, who will take measures to correct the evil.

I was appointed to investigate a waterworks on which there had been an inquiry of this kind, and I proved that most of the wealthiest manufacturers were daily stealing large amounts of water, and that less than half the amount of water provided by the ratepayers of the town was paid or accounted for. The result of the Government interference in this case was a saving to the public taxes of about $30,000 each year afterwards.

Mr. Griffith, C.E., states that under proper management the advantages of local authorities owning their own waterworks are as follows:—

1. A local authority elected by residents in the districts has a greater personal interest in the matter of supply, and is better qualified to administer the undertaking in their own interest than a private company, whose only object is profits.

2. A local authority need not make any profit out of the supply. They can also borrow capital for construction of the works cheaper than a private firm and reduce the charges for supply to consumers accordingly.

3. Public sentiment is always in favor of having such a universal necessary of life and health in their own hands.

The chief difficulties against public ownership are:

1. The periodical changes of council, and sometimes even the constitution, which often interferes with the continuity of a policy.

2. The liability of the works being handled by men appointed through society, family or political influences, in place of having skilled mechanics and experts.

3. The habit, which is sometimes allowed or blindly ignored, of selling favors and accepting perquisites, which often is the cause of scamp work being done, and of public works costing more than similar works done by private business firms, or such well conducted councils as Glasgow.

The revenue from the sale of water in Toronto is stated in the newspapers to be $445,000; taking the population at the highest stated number, viz., 190,000, it runs about $2.30 per head; an average for each house of five inmates of $11.50. They say we owe on account of the waterworks $3,817,287.32, or an average per head of $20.09. Had the Toronto waterworks been constructed and managed by a business firm with the ability of the T. Eaton Co., for example, it would not have cost half, and the charge to consumers could have been proportionately less.

There cannot be a great difference between the need for water in European and Canadian towns which have similar conditions, only that English towns use a great percentage of their water in supplying cheap public swimming baths of large dimensions. The difference in consumption has no connection with the fact that the heat or cold is more excessive, because the returns given us of the water pumped in Toronto in the months of April and November, when there is no garden or street watering, public water fountains, no frost needing taps to be kept running, nor anything at all different to any British town, gives only a little different figures to those published for any of the other ten months.

Mr. Palmer, C.E., states that the Malvern authorities supply each water consumer with a meter, and the average consumption is 5½ gallons per head per day. I know several small towns that do not use meters which use less than 6 gallons of water for household purposes per head per day. The total quantity of water used for all purposes in the town of Nottingham, with a population of 250,843 last year, was stated to be under 21½ gallons per head per day. In Bradford, a town of 240,000 inhabitants, they used 26 gallons per head through meter for manufacturing purposes, and about 27 for all other purposes, including several large swimming baths. Mr. Bateman states that he tested a group of 14 towns in England, and found the average consumption for all purposes was 24 gallons, and in a single group of working class houses, containing 82 inmates, the average consumption per day per head was 7½ gallons. I myself tested a house in Toronto by having a new Siemens water meter fixed on for five years. The house had eleven inmates, two baths, one basin, w.c., hot water and range boilers, hose pipe, stable and horse. The average amount of water taken each year was under 28,000 gallons, less than 7 gallons per head per day.

The Toronto *Star*, on May 1st, stated that only 198,000,000 gallons of water were sold to manufacturers in a year in Toronto, or under three gallons per head, leaving about 100 gallons per head per day for sanitary and domestic consumption, or 75 gallons over the consumption of similar British towns. If Toronto were situated in England, there would be a government inquiry into the cause of this waste. Returning again to the mechanical and engineering side of the subject, as I have before stated, the best water for public use is rain water collected from clean land, because it cannot possibly be contaminated by mineral, manurial or sewage deposits. Taking a supply from a river near its source, or from an elevated lake, is often as good as collecting rain water. When taken from a

river, the mouth of the suction pipe should face the way the water flows, because by so doing the best water will be drawn in, while the floating impurities will pass forward with the current. When from a lake, it should face downward for the same reasons. Taking water from a lower level than the town is built on is often injudicious, because it may be fouled by the sewage from the population living within the watershed, which sometimes contains an area of several thousand square miles, and should the population be small at present, and the impurities from the sewage imperceptible, it may soon alter. All large towns should have forethought sufficient to arrange for a good permanent supply while the opportunity serves. To depend on a supply by pumping and long suction conduits is risky and expensive, and it is probably cheaper to carry a supply fifty miles and have a proper gravitation system. (1) Because the source of supply being necessarily at a higher elevation than a pumping source, it is less liable to be contaminated. (2) Though the first cost of works may be more on account of the long length of trunk mains which might have to be conveyed through tunnels and across ravines on viaducts, yet the annual expenses of pumping in wages, repairs, renewals, etc., will probably amount to more than would pay the interest on the capital expended on a comprehensive, well engineered scheme. Such a plant would be safe and permanent, besides free from contamination, because by making judicious arrangements to supply the villages located on the route of the pipe, by measure, sufficient revenue might be collected to pay the interest on the cost of running the trunk pipe through their section of territory.

When it is necessary to store water in reservoirs so that the supply can be abundant when the rainfall is least, such reservoirs should be carefully covered over and ventilated. In form they should be deep rather than extended, so as to lessen the evaporation, to keep the water cool and at an even temperature as far as possible all the year round, to prevent the water from absorbing the impure gases from the atmosphere, and prevent the sun's rays from increasing the microbes and bacteria. When large natural reservoirs are made in the hills they must necessarily be open, and the face of the water exposed to the sun and air; such water should be passed through a good, clean filter immediately before entering the supply pipes. In fact all water, however collected and stored, should be filtered.

It is a fact that the purer and softer the water is the easier it is to contaminate. It will attract and absorb minerals and poisonous gases with a wolfish appetite. At Harrogate in England there are eleven springs of water, each loaded with different minerals and chemicals, which each stream has taken up on its passage through the earth from the seat of the rainfall to the springs.

Then another example: Six families living in good, airy, isolated houses, went on their holidays for a few weeks to the seaside. A short time after each family returned home some of its members were taken ill with typhoid fever. Being superintendent of the water supply, it was my duty to investigate so remarkable an occurrence, and found that the owner had broken the laws of water distribution by allowing his tenants to take the whole of their water supply from a large shallow open cistern hidden in the false roof that was open from end to end over all the sleeping rooms of the six houses, and that the loft had no ventilation whatsoever; so that all the poison contained in the atmosphere of the sleeping rooms passed through the porous plastered ceiling, and having no other means of escape was absorbed by the sheet of water in the cistern, and the water became poisoned before being used by the inmates. A French writer, has indeed proved that the human system can be trained to receive large doses of poison without serious injury. If his theory was incorrect, how could so many people live in a poisoned atmosphere, yet have general good health. The trouble with this group of families was that they had lived at another place for a time and broken the continuity of the doses, and when they returned home and began to take them up again on a healthy, well-ordered constitution, the sudden start upset them. The water would be worse than usual on account of a small quantity only having been used during the time of absence. I have related this at length to show the great importance of covering fresh water tanks and reservoirs, and the advisability of erecting them in places sufficiently removed from any chance of contamination.

With the object of removing dirt from the lower points of street water mains, some engineers connect the ends of the pipes together and form a circuit of water down one street and up another. The method does not remove the evil, but distributes over a larger area the dirt or polluted water in the pipes. I believe the circulating policy is adopted in Toronto, for I am sometimes engaged to remove fish and other obstructions from taps and valves. I also notice if a bath full of fresh water stands for a few days, there is a sediment at the bottom. Then water taps and other waterworks appliances only keep in good condition about a quarter as long as at places where the water is free from fine sand and grit. The cost of repairs and renewals on account of fittings being injured by the grit must amount to a large sum throughout the whole city. I once witnessed water flowing from a branch pipe from which a fire hydrant had been removed run black for about fifteen minutes, leaving a large quantity of gritty deposits on the ground, and at another time a six-inch water main that had been taken out on account of a defect, had about one inch of black and green sludge adhering to the lower side.

The dirt could not lie in that position, nor the water get so far polluted as to run dirt for so long a time, if reasonable provision were made to clean out the pipes and suction conduit, and the conduit were laid in such a mechanical way that the joints could be kept permanently water tight. I don't see how they can be kept tight during the alteration of the temperature of the water they lie in, if the sketch shown in the *Telegram* newspaper be correct and reliable. The proper way in my opinion to lay down distribution water mains for a town is to lay the large carrying mains along the roads having the highest elevation, and take out branches commencing with a cut-off valve and air ball, then continue them down along the streets to the lowest points of each street or section of streets, and on the terminating end of each branch pipe affix a full-sized sluice valve about ten yards beyond the last service pipe. Round the sluice valve build a well or valve chamber with a gully trap and drain pipe twice as large as the water pipe, and construct the bottom one foot below the valve. Solids and impurities of all kinds contained in water mains that are under pressure are always forced to the lowest points, and can be easily removed by opening the terminating valves, about once a month or oftener, according to the quality of the water, for about one half minute.

Water mains should be as carefully graded as gas or sewer pipes, and have air balls of the self-acting kind (Fig. 1) fixed at all the highest points, and full-

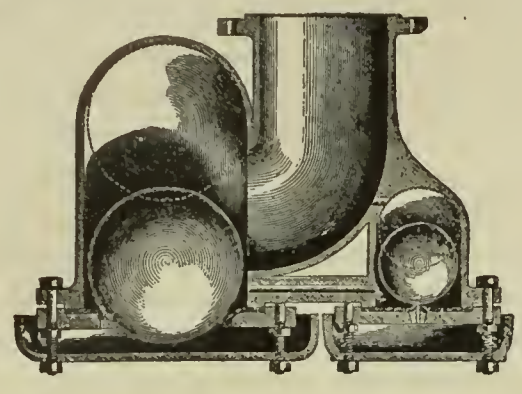


FIG. 1.

sized sluice valves at all the lowest points and dips, so that the whole system may be emptied and cleaned when necessary, and freed from deposits of grit and slime.

It must be remembered that water will run through water without moving the water adhering to the sides of the pipe it is passing through, and if the mains are larger than is needed to pass the supply taken from them, and the water is soft and pure, the motionless water clinging to the sides will set up an action with the metal and become hardened and turn into a brown calcareous matter, and continue to grow and diminish the bore of the pipe until there is just sufficient room to pass the necessary stream, when it will stop and continue in that shape for any length of time. For example, I inspected a fire hydrant intended to protect an isolated hall in a corner of a town, and found that it would not deliver any more water than the common bib water tap on the kitchen sink. On cutting the three-inch main to find the cause, I found it calcarized and the bore reduced as above stated, and the whole of that branch line for about one half mile had to be relaid with new pipes. Had the terminating sluice valve been open full wide once a month, and the dead water clinging to the sides of the pipe let out, along with any calcareous scales that might have started to form, it would never have been necessary to relay, and the hall would not have been in jeopardy for several years.

A 30-inch earthen pipe having cemented joints, that carried water from one storage reservoir to another on the moor land, got its bore diminished by fine rootlets passing through the cracks in the cement joints, growing inside and choking the interior. The calcareous matter growing on the inside of water mains can be removed by a machine called a ferret, which is so constructed that the pressure of water turned on behind it will force it through a moderate length of water pipe, and during its passage it will scrape the inside clean. When this method is used, clean-out doors must be provided at short intervals.

Neither large nor small water filters are of any use except proper provision is made for cleaning them easily, because no matter what material is used for a filtrate there is a limit to its usefulness. The best filters are made from either animal charcoal well pressed together, so that the water must pass through the coal, or magnetic carbide of iron. For purifying fresh water that is void of sewage deposits, about 15 inches of fine washed, clean, sharp sand and 20 inches of gravel will make a suitable filter, if the top layer is removed and clean washed; then spread on again about once each week. This will make the water of a bright color and pure. If I were to build a filter on a large scale I should have a graded concrete bottom, so that the water on escaping from the filtrate material would come together and form a stream to enter the distribution pipes. I would then have a false grated bottom, bearing on pillars, to hold the filtrate material. I would run the water to be treated over shallow troughs, the bottoms pierced with very fine holes at a convenient elevation above the filter, so that all the water intended to be filtered would fall into the filter in a fine spray similar to a needle bath; falling a distance say of four feet, in the form of a fine spray, the water would be aerated. I would also make a good system of ventilation that would insure a strong current of air to be continually passing between the cemented and false grating floor at the bottom of the filter. The water should pass slowly through at a pressure of about two feet above the face of the sand.

When water is delivered to consumers the shut-off tap usually fixed in the sidewalk near the street line should be of the screw-down pattern with the valve working loose inside, so that when full open it would allow water to pass through towards the house, but it would not allow any to return back into the mains. The tap would have a double action; it would not only make a first-class stop tap, but also a foot or check valve. (See sketch of the loose valve inside the bib tap shown.) This would prevent any fluid being forced or

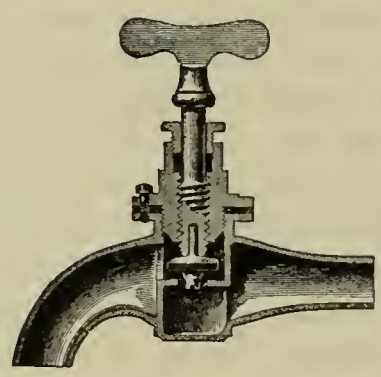


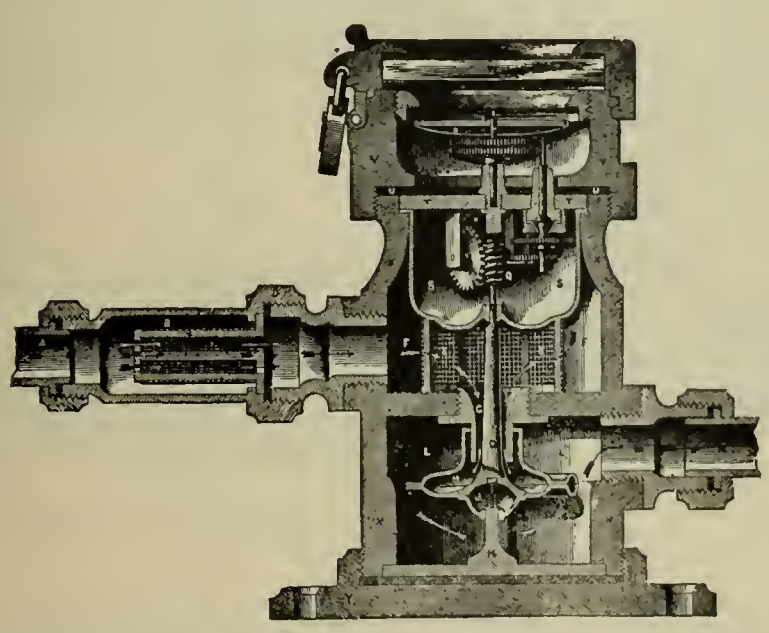
FIG. 2.

drawn into the street mains, and effectually prevent the return of hot and tainted water from water-heating boilers, steam and range boilers, etc., which is at present very prevalent.

Lead water pipes when laid in the earth should not be near any metal, because a galvanic action will be produced; nor near an electric car line, for the electricity will damage the lead if the soil it lies in is damp and a good electric conductor. Nor should it be laid near any tile or other drain, because a leakage of water would find a downward way of escape, and could not be easily found; nor under any manure pipe, or near dirt or filth of any kind, because when the water is motionless in the pipe it will absorb some of the foul gas thrown off from such filth through the lead coating, and become tainted. Lead is the handiest metal for small water pipes, because it can be easily bent to any angle. When damaged by frost or water hammer it is easy to repair without removal. When laid underground it will sink with the soil, stretch, or give and take a little without injury. On the other hand, when rigid iron is used it will break before bending, and if damaged a full length has to come out. It is very unfortunate that a chemical action sets up between pure soft water and lead, which poisons the water when it stands motionless in the pipe for a few hours, and thousands have been seriously injured in health by drinking and cooking with water poisoned in that way. The water that poisoned the Louis Philip family of Claremont contained seven-sixteenths of a grain of lead per gallon, and the water taken from the same source had injured to various degrees thirty-four per cent. of

the population of the town. Analysts differ as to whether water can be poisoned by passing through galvanized or zinc pipes or not. I am positive that distilled water can be injured by using galvanized vessels, and if so other water must be injured to a less degree. Black iron, specially made very strong and soft in nature, so that it can be bent easily, is the healthiest article for use for service pipes. Some of the means suggested for removing the evil and still using lead pipes for domestic water supply, are: 1. To line the lead pipe one-sixteenth of an inch thick with block tin; 2. To give the pipes a bituminous coating; 3. To boil the lead pipe before using in a strong solution of sulphur and soda.

As a superintendent of waterworks, I have had the responsibility and care of many Siemens and Adams water meters, which are used largely because they are light and handy to fix. They are simple in construction, measuring the water by forcing it through a turbine or baker's wheel very similar to garden sprinklers that spin round when delivering the water. The act of the turbine turning round moves the dials and registers the quantity. I have never seen large meters of this kind in use. A meter to insure accuracy for a long period must measure the water by loading and unloading a vessel similar to a dry gas meter. When the Siemens pattern and all similar meters become worn, or the inside gets thickly coated with scale or dirt, the water will pass through unregistered, and they can also be easily tampered with. I here show a sketch and give the manufacturer's own description.



This meter is constructed upon the well known principle of Barker's mill The measuring medium consists of a drum, working on an upright spindle at the bottom, and in a collar at the top. The water is conveyed by the conducting tube into the centre of the drum, and allowed to escape at three or more apertures on the periphery of the same, giving to it a rotary motion. At each revolution of the drum a certain number of cubic inches of water is delivered, so that it is only necessary to register the number of revolutions to ascertain the quantity; this is effected by wheels and pinions, and the result indicated in gallons or feet, upon a graduated dial.

In conclusion, I may say that when the steel conduit was about being laid down across Toronto bay, I suggested, in a letter to the *Globe*, printed January 18th, 1888, that a subway should be made from the north side of the railway tracks to the nearest point of the Island, large enough for a car track, a carriage-way and two sidewalks for foot passengers; that the sidewalks should be raised similar to the long subway at Montreal, and that two conduits, one under each sidewalk, should be laid on blocks or rollers so that the tube could be easily inspected; after leaving the subway the two conduits should be joined and conveyed across the Island to the intake, trenched into the ground. Until something in this way be done to make Toronto supply from Lake Ontario a safe and permanent source, free from the contaminating influence of the filthy bay water, the supply will remain risky and polluted when the conduit leaks, or is loaded with sand.

ELECTRICITY IN RAISING OIL.

An interesting and highly successful experiment has been carried out at Petrolia by W. H. Ashworth, manager and electrician of the Electric Light Company of that town, in applying electricity to the pumping of oil. Out of the 8,000 oil wells, which yielded about 800,000 barrels in Canada last year, there are nearly 6,000 in and around Petrolia. One would think that in a town like Petrolia, where they have "oil to burn," so to speak, they would use some kind of crude oil engine, or at least use oil as fuel for the steam engines that are required on the fields. But they do neither. They use steam engines to work the pumps that lift the crude oil, and they use wood and coal for fuel for these engines. As those acquainted with the petroleum business know, the wells are bored in all directions about the town, many of them in the back yards of the owners' houses; so that the visitor on approaching the town sees a forest of derricks, looking like the stumps of trees left after a fire has passed through a green forest. Under each derrick is a well, worked either by a "walking beam" or a "kicker"—that is, two arms joined at right angles, one arm slanting vertically, the other horizontally, the latter having the pump rod attached to its outer end. A group or "batch" of these wells are operated from one engine, rods and scantlings being connected from the engines to the kickers and walking beams. The wells run by one engine are at all kinds of angles to each other, this being easily accomplished by a crude horizontal wheel, making a quarter turn and back, and so pushing and pulling the rods of the pumps on its line. By putting a wheel whenever a well has to be reached at an angle, a dozen or even thirty wells may be reached from a single engine. Mr. Ashworth last July undertook to operate a "batch" of wells from the dynamo in the Petrolia Electric Light Co.'s power house, and installed a six K. W. 500-volt Canadian general machine in a small building in the field beside one of the old engine houses. The little shed required for the purpose was only half the size of the steam power house, and no heavy foundation or boiler setting was required. The machine was placed on a frame consisting of two pieces of 10" by 10" timber on each side, one on top of the other, to give a clearance from the ground for the driving gear, which was a set of pulleys belted so as to reduce the motion imparted from a main shaft operating a crank at either end, the two cranks being placed so as to give an alternate motion to the two sets of pump rods; this simple apparatus was attached to 16 very heavy wells known as "water wells," and running at much higher than the usual speed, but they have been run most successfully by electricity ever since. No boy or man is required for firing, and the machine requires no attention after it is started each day. Last year in Ohio or Pennsylvania one or two wells were experimentally operated by electricity, there being a separate dynamo for each well, but this, we believe, is the first case on record when a "batch" of wells has been electrically operated.

James Lydiatt, formerly of the Wallaceburg, Ont., Glass Works, proposes to start a glass factory in London, Ont., which has the necessary sand near as well as superior railway facilities. The city is of course expected to assist the project.

THE LACHINE RAPIDS POWER PLANT, MONTREAL.*

BY WM. I. BISHOP, MONTREAL.

The problem of utilizing the power of the St. Lawrence River at Lachine Rapids, near Montreal, is one which has for many years engaged the attention of engineers and capitalists. Their almost unanimous opinion has been, however, that although considerable power could be obtained during the summer months, the drowning of the rapids during high water would so reduce this that any scheme requiring continuous power the whole year round would not be feasible. Support was given to this idea by facts observed during the running of a small grist mill erected on the site, for which power was obtained by throwing out a small wing dam. This mill was compelled to shut down during a part of the winter, owing to back water. Another serious objection was that great quantities of frazil or anchor ice run through the rapids almost all winter, and it was thought impossible to prevent its filling up the head race and wheels.

About five years ago Messrs. T. Pringle & Son and W. McLea Wallbank, of Montreal, after a careful study of the question, came to the conclusion (which has been proved since the river bed has been laid bare) that the backing up of the water and drowning of the rapids was caused by the great bars of rock which rise out of the river bed at an acute angle, facilitating the collection of frazil and the formation of natural ice dams.

The Lachine Rapids are probably the most famous of the series of rapids along the St. Lawrence River from Lake Ontario to Montreal. Every one who has ever taken the steamer trip down them, which is one of the most enjoyable experiences of every pleasure-seeker's visit to that city, will recall the rock barriers, which make their presence manifest to the practiced eye by the turmoil of the waters, even when wholly submerged.

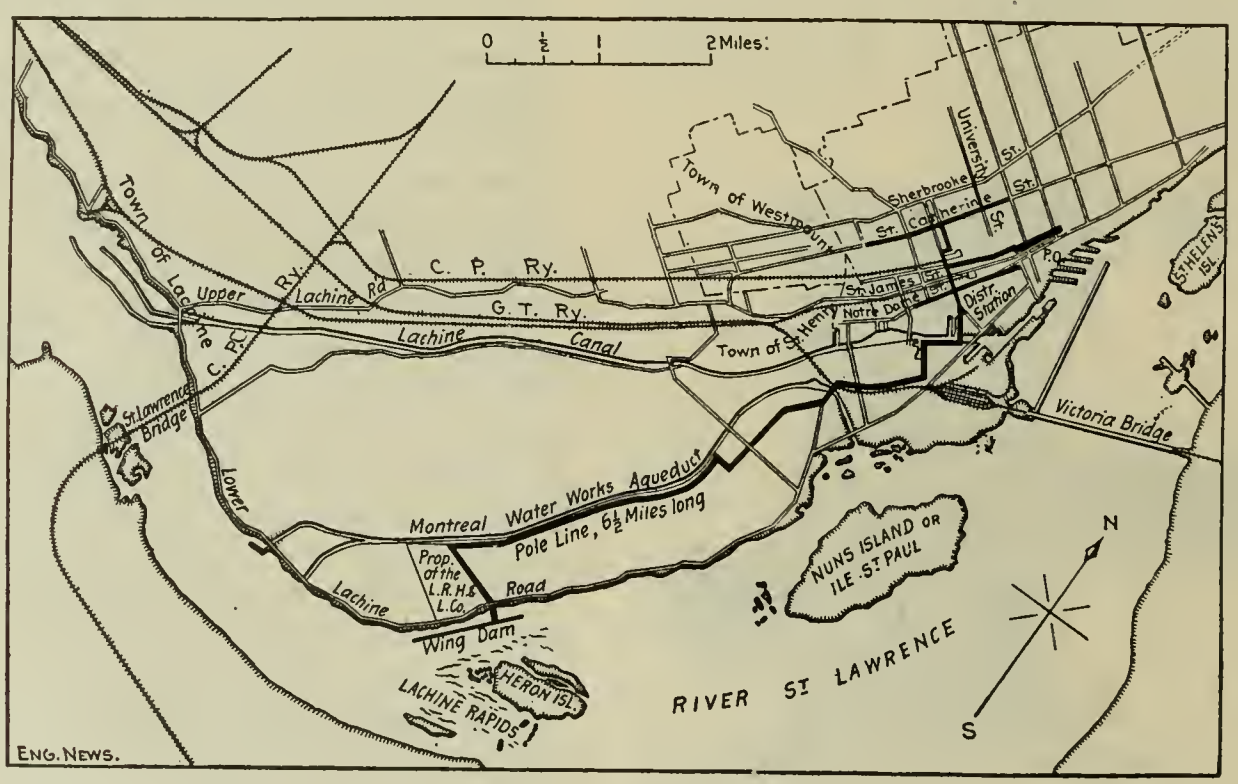


FIG. I—MAP SHOWING THE LOCATION OF THE POWER PLANT AND POLE LINE OF THE LACHINE RAPIDS HYDRAULIC AND LAND CO.

Above the rapids the river widens into a broad expanse, known as Lake St. Louis, some six miles wide and 14 miles long. The rapids themselves are about five miles in length, and their total fall is about 30 feet. Briefly stated, the plan for power development which is being carried out by the Lachine Rapids Hydraulic & Land Co., is to project a dam into the stream at a point about one mile above the foot of the rapids, and by a dike parallel to the river bank and extending up stream 5,000 feet from the river end of this dam, to make a broad head race, which will take water from a point where the water on the rapids is about 11 ft. higher than the dam. Below the dam there is a further fall of about 10 ft. in a distance of about a mile to the foot of the rapids.

The works are designed to utilize 15,000 cubic feet of water per second, which will be about 10 per cent. of the entire flow of the river at low water.

The general map of the rapids shown gives a good idea of the location of the company's power plant with reference to the rapids and the city of Montreal.

GENERAL DESCRIPTION OF WORKS.

By reference to the general plan (Fig. 2) it will be noted that the present scheme, as now being carried out, will consist of: (1) A head race 3,705 feet long, formed by a wing dam composed of a 40-foot masonry ice breaker at the entrance, 3,305 feet of overflow cribwork, and 360 feet of cribwork carried up square to the same level as the top of the piers of the main dam. (2) A main dam of 43 masonry piers on concrete foundations, the piers being 4 feet thick and 17 feet high above the level of the floor of the flumes and the top of the foundation. The piers form 36 flumes, three waste weirs, and the foundations for three power houses. (3) A guard dam forming the tail race, consisting of 300 feet of cribwork 10 feet wide and 900 feet of embankment formed of rock taken from excavations. (4) A system of booms and cribwork piers designed to keep the wheels clear of floating ice, driftwood, grass, etc.

The head race is to be excavated to a depth of 12 feet below the top of the overflow dam, and is at the narrowest point near the entrance 525 feet wide, with a sectional area of 6,300 square feet, so that, allowing a discharge of 200 cubic feet per second from each wheel, or a total of 14,400 cubic feet for 72 wheels, the velocity of flow past this point will amount to about 2.3 feet per second. As the head race widens out to nearly 1,000 feet at the flumes, this velocity will, of course, be much reduced, so that there will be little, if any, lost head due to an excessive speed of current.

The current in the river just above the entrance to the head race runs at the rate of about six miles per hour, and this striking a body of water moving at the rate of only two-thirds mile per hour will give it a tendency to strike almost directly outwards, carrying with it most of the frazil, driftwood, etc., that it may contain. It is also a fact that the current has always had a tendency to strike outwards at this point, owing to a curve in the river bank just above the head-race entrance.

The water in the head race will freeze over completely in winter; and, as is well known, no frazil will form under the ice; but should any commence running before the ice forms, the racks are so hinged and arranged that they can be lowered to the bottom, or taken out completely, allowing it to run through the wheels. The crib piers and booms are so arranged that there will be no danger of the ice shoving down on to and destroying the racks. The greater part of whatever ice forms in the head race will go over the overflow dam, and the small balance will go through the waste weirs without trouble.

CONSTRUCTION OF FALSE DAMS.

Work was commenced in the fall of 1895 by throwing out a false dam (Figs. 2, 3 and 4) of stone and earth at right angles to the shore; then by running a short wing dam down stream, enough of the river bed was made bare (Fig. 5) to enable the contractors to get sufficient stone by excavation to grade to continue the dam further out into the river, and to commence running a wing dam down to the site of the main dam, on which are the wheel houses. Every foot added to the wing dam down stream, laid more of the river bed bare and allowed excavation to be made down to grade. This work was carried on during most of the winter by means of steam drills, and the rock taken out was used to construct another dam (Fig. 2) at right angles to the shore, 150 feet above the extreme upper end of the proposed wing dams. These two false dams were connected during the past season, and when they were sufficiently advanced an opening was made in the lower dam and the water in the upper portion drained out, enabling the whole of the work to be done on a comparatively dry river bed.

* From the *Engineering News*, New York.

Much trouble was experienced in building these dams, owing to the raging current which at several places swept away 75 per cent. of the material, consisting of large boulders, etc., as fast as it was dumped in. The fact of their having been built of such large stones has also given the dams a tendency to leak badly, in spite of banking with earth mixed with pea-straw, etc.

CRIBWORK.

The cribwork dams were then commenced. These consist of, first, a high crib 360 feet long (Fig. 6) built of 12 x 12-inch face timbers laid to 2-inch joints with 8-inch flatted ties laid 8 feet apart in each course and 8-inch longitudinals; and, second, 3,305 feet of overflow crib with 12 x 12-inch longitudinals and purlines. The top is hipped up with an easy slope on the shore side and covered with 2-inch plank and 8-inch tamarac split poles with the bark on. The slope on the side towards the river is steeper, and is covered with 8-inch tamarac squared on three sides and laid on purlines. The vertical face of the whole dam on the shore side is sheeted with two layers of 2-inch plank and an ample talus of gravel is laid along the shore side. Both cribs are filled with carefully placed stone of moderate size, and are scribed and bolted to the rock when above the grade adopted for the bottom of the head race, 12 feet below the top of the main dam. Below this it is considered that the stone filling is ample security, and the cribwork is merely scribed to fit closely to the rock. The wing dam cribwork, above the main dam, is 20 feet wide at the bottom, and the cross ties are run entirely through wherever possible.

The masonry ice breaker at the upper end of the wing dam is 40 feet long and 20 feet wide; it is built on a concrete foundation two-thirds the depth of the water (which is 21 feet deep at this point), of rough bush-hammered masonry. The top is bevelled to 5 feet below the water line, and 1½-inch chains are imbedded in the concrete to fasten the upper boom.

piers. The piers are 4 feet thick by 48 feet long, 21 feet 6 inches c to c for both flumes and waste weirs

POWER HOUSES (FIG. 9).

The power house walls are built in a similar manner, and contain between them massive concrete foundations for the generators. The walls are four feet thick along the front and sides to the line of the down-stream end of the piers; beyond this the masonry is only 3 feet thick and 3 feet high, with a 16-inch brick wall up to the top of the piers.

The generator foundations are constructed in the form of heavy columns with arches between, and afford every facility for getting at the holding down bolts of the generators.

Vacant spaces between and behind the foundations are filled with stone flushed over with eight inches of concrete up to the same level as the flume floors or tail water. These spaces will be utilized for heating apparatus, storage, etc., and will be accessible by a spiral staircase and a hatchway 4 x 5 feet.

SHORE ABUTMENT.

The shore abutment (Fig. 15) is also built of masonry four feet thick, and from the line of the rack runs into the bank in a sloping direction. This sloping portion is backed with three feet of clay puddle up to the frost line, four feet below the ground level. There is also a wing wall 12 feet behind this of concrete, three feet thick, running 23 feet into the bank.

The portion of the abutment next the flume is backed with concrete four feet thick, running up six feet above the flume floor, and with clay puddle three feet thick above this up to the frost line. These precautions are taken to preclude any possibility of leakage around the back of the abutments.

A cribwork embankment is carried along the shore from the corner of the abutment to a point about 50 feet up-stream. All ties in this crib are kept so that the ends will be below the frost line

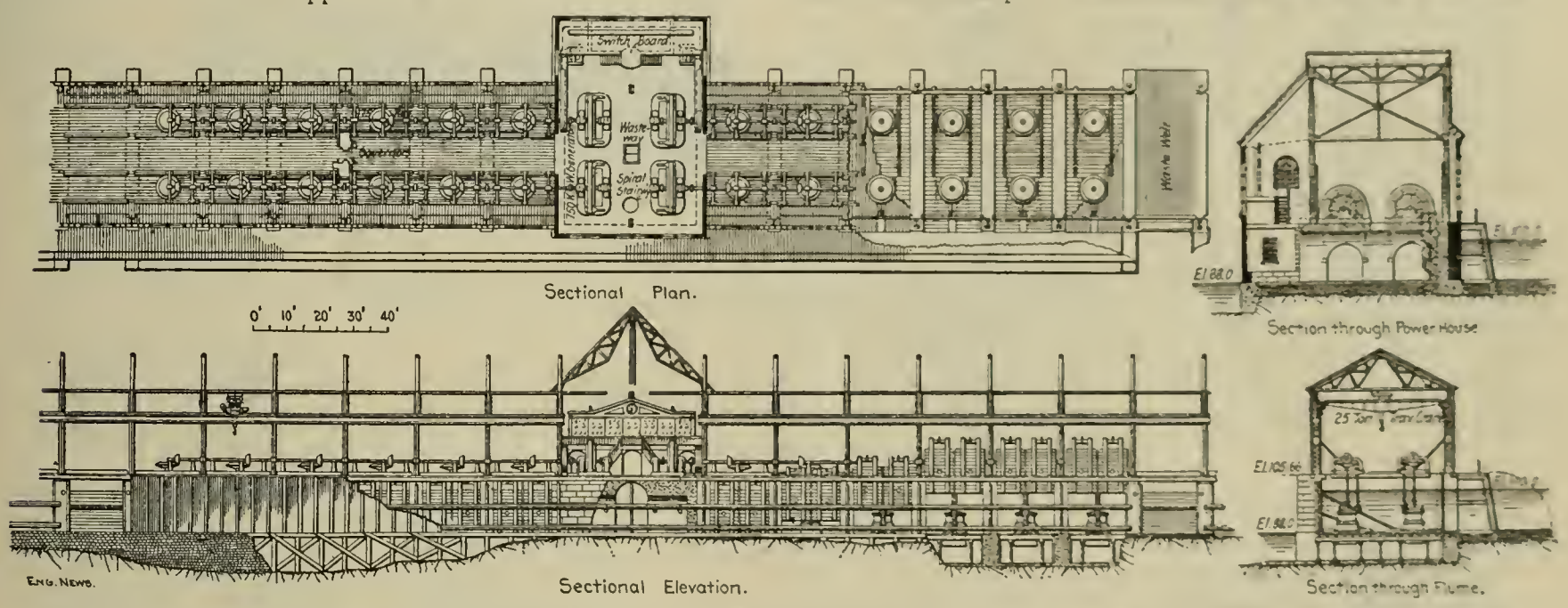


FIG. 9—DIVISIONS THREE AND FOUR OF MAIN DAM, SHOWING PLAN, ELEVATION AND SECTION OF POWER HOUSE AND TURBINE SETTINGS

MAIN DAM.

The main dam piers (Fig. 7) are built of rough bush-hammered masonry 4 feet thick, laid on a concrete foundation 4 feet 6 inches thick, which runs up to the level of the flume floor. The rock under the wheel pits was first excavated and levelled off, and owing to its shaly and unreliable nature a layer of concrete 1 foot thick, composed of 2 parts sand, 1 part Portland cement, and 6 parts stone (these proportions were used throughout the work), was laid over it, holes being left to receive the columns supporting the flume bottoms. Caissons (Fig. 8) of 2 x 4-inch stuff, laid on the flat and well tied through, were then run up to the level of the underside of the timbers supporting the flume floor. These timbers of 12 x 15-inch pine were then laid, running back 15 inches into the concrete, and were bevelled off so as not to weaken the foundation.

The caissons were brought up to the level of the flume floor and filled with concrete. Two longitudinals of 10 x 12-inch British Columbia fir were run under the floor timbers and 15 inches into the caissons along the front of the flume. These are each supported by six 6-inch I-beam columns placed in holes in the wheel pit bottom above mentioned, which were then flushed up. Masonry was then laid on this foundation to a height of 17 feet above the flume floor. This masonry is of a very high class character, the blocks being extremely large and averaging about 2 feet in thickness; they are laid in cement mortar, composed of 2 parts of sand to 1 of cement.

Two recesses, 12 x 8 inches, 36 feet apart, are provided for the gates and stop logs, the down-stream one being 6 feet from the back of he piers, and the up-stream one being 4 feet from the front of the

WASTE WEIRS (FIG. 10).

The floor timbers and flooring for the waste weirs are finished in the same way as the flumes; 12 x 12-inch stop logs are laid in the up-stream check, and the upper four of these can be taken out and replaced to suit the level of the head water. A heavy timber slide is built over the floor for ice, etc.

Arrangements were made to drain the water through the waste weirs under the flooring during construction. This was done by omitting the concrete wall along the front from the rock bottom up, and by placing slides into which one set of 12 x 12 stop logs, and one set of 2 x 4 stop logs will be dropped and the space between filled with concrete, when the construction is completed.

HEAD GATES.

Each flume is provided with a set of two head gates of pine, 5 inches thick, for a height of 5 feet, and 4 inches thick above, with an iron sliding filling gate in each, and two 8 x 4 inch uprights with a cross piece between fitted with wrought-iron shackle to raise the gates by. The head gates move in slides fitted into the check in the masonry and fastened to an upright in the centre of the flume consisting of a 15-inch I-beam and an 8-inch channel into which a strip of wood is fitted, and to this the distance piece between the two gates is screwed. This upright is braced just at the water line by a 20 inch I-beam running across the flume and 11 inches into the wall on each side; it is securely fastened at the bottom to an iron plate nine feet long, two feet wide and half-inch thick rag-spiked to the floor timbers.

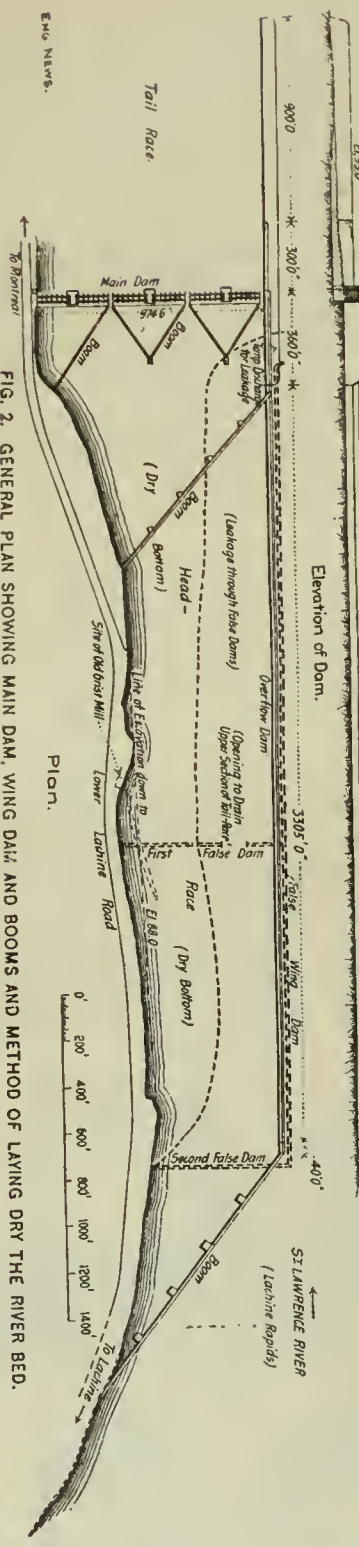
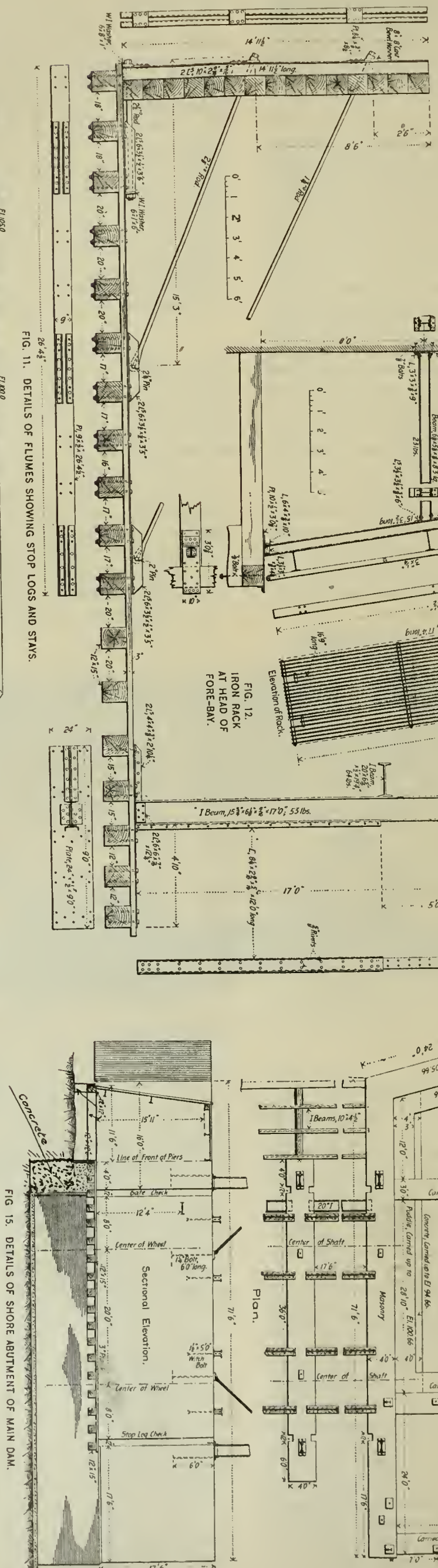


FIG. 2. GENERAL PLAN SHOWING MAIN DAM, WING DAM AND BOOMS AND METHOD OF LAYING DRY THE RIVER BED.


Pl. 84"x1/2"
2 L's 10"x2 1/2"x1/2"
14'11 1/2" long.
W.I. Hasting 67'10"
Pl. 96"x1/2"
Pl. 91"x1/2"x26'4 1/2"
2 Pins
2 L's 6"x3 1/2"x3/8"
Pl. 102"x3/8"
Pl. 96"x1/2"x26'4 1/2"
2 L's 6"x3 1/2"x1/2"
Pl. 84"x28 1/2"x1/2"x12'0" long
Plate 24"x1/2"x9'0"
1 Beam, 15 3/4"x6 1/2"x3/8"x17'0"; 55 lbs.
5'0"
17'0"
4'10"
Pl. 102"x3/8"
Pl. 96"x1/2"
Pl. 91"x1/2"
Pl. 84"x1/2

The gates are intended to be raised and lowered by a travelling crane, and will probably be taken out and stored under water after the wheels commence running, as they would obstruct the light if left in position. The space between the top of the gates and the flooring of the building is filled with three-inch plank laid in the check and bolted to the upright behind the gates.

STOP LOGS.

The stop logs (Fig. 11) are 12 x 12 inches, laid into 8 x 12-inch recesses in the piers and braced by two sets of iron eye bolts, three in each brace, running diagonally down to the flume floor and pin-connected to the angle-iron fastenings, which are riveted to an iron plate 9 x ½-inch x 26 feet 4 inches bolted to the floor timbers. These bolts run out to a bevel casting, bearing on the channel iron uprights, and are provided with a nut at the outer end and can be removed if necessary. The uprights are formed of two 10-inch channels placed back to back with a space for bolts between, and held together with cross plates just under the bevel castings. These braces are so placed as to take all strain off the masonry piers.

RACK AND BRIDGE.

The rack and bridge framing rests on 12 x 12-inch timbers running lengthwise of the main dam and 11 feet 6 inches from the front of the piers, well supported by 12 x 12 uprights; a butting piece is placed at each pier and braced where necessary by 3-inch plank.

This framing is laid level with the flume floor and is omitted in front of the waste weirs. The rack and bridge rest on steel frame-work constructed of 6-inch I-beam uprights, 12-inch I-beams running lengthwise between piers to support the racks, while 10-inch I-beams are under the bridge floor, which is about 6 feet wide. The outer one of the bridge beams is faced with a 10-inch timber against which the rack rests. The rack (Fig. 12) is made of 3 x ¼-inch bars, 17 feet long, laid to 2¼-inch centres in sections 4 feet 3½ inches wide, well bolted through and with thimbles between each bar. Each section is supported on two castings (Fig. 13) so

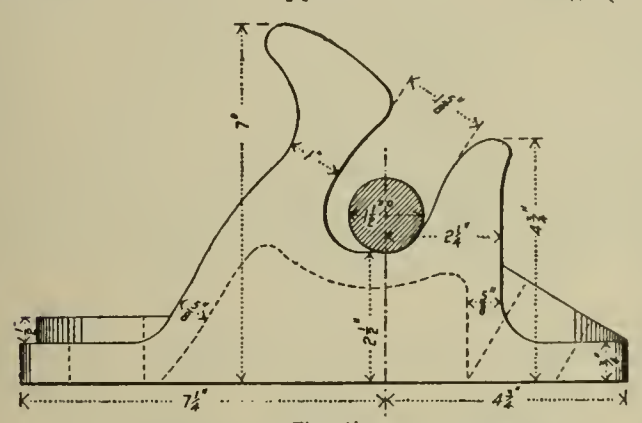


FIG 13.—CASTINGS FORMING HINGE SUPPORT OF RACK FOR PROTECTING THE TURBINESOF THE LACHINE RAPIDS POWER PLANT.

shaped that the rack may be swung over so as to lay on the head race bottom (which will be levelled off in readiness), or it can be easily taken out and replaced without the necessity of sending down a diver to unfasten the bolts.

The rack is constructed in this manner so that it may be taken out of the way in order to pass frazil through the wheels, in case the frazil should begin running before ice forms over the head race. If the rack were permanently secured in the ordinary way, the frazil would adhere to the rack bars and impede the flow of the water.

The bridge beams are floored over with 2-inch plank, and a rail is carried along the bridge about 2 feet from the edge, giving ample room for a man to rake the rack.

BOOMS.

The system of booms (Fig. 2) is as follows: (1) At the entrance to the head race on a very easy rake will be placed a boom 1,340 feet long, constructed in the form of a Howe truss, the chords being three 12 x 12-inch timbers, the main braces 3-inch plank, and the counterbraces 4 x 12-inch timbers.

The 3-inch plank is laid solid on the top and bottom, and between the 12 x 12-inch timbers and the 4 x 12-inch timbers are placed on edge between the layers of plank. The whole is securely spiked and bolted every 8 feet with three bolts, one through each 12 x 12-inch timber, the bolt diameters varying from 1¼ inch to 1¾ inch.

The boom is in sections 250 feet long, with a clear span of 220 feet, and is 14 feet wide and 4 feet deep. Its details are illustrated in Fig. 16. It will be securely fastened to the shore and the ice-

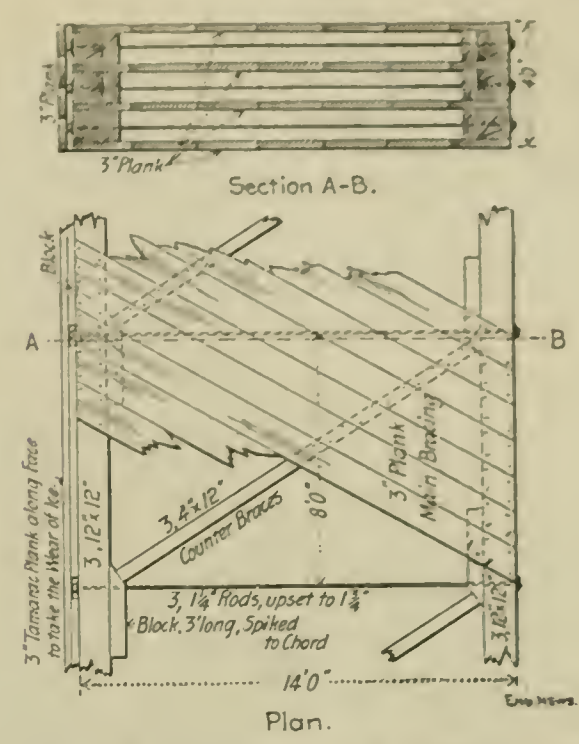


FIG. 16.—HOWE TRUSS FORMING BOOM ACROSS HEAD RACE

breaker, and will be supported by four crib piers, 30 feet square, constructed of 12 x 12-inch timbers and filled with stone.

These cribs are made large, as they stand in about 25 feet of water. (2) At the lower end of the overflow dam will be placed a boom 1,000 feet long, constructed of three 12 x 12-inch timbers fastened with 1¼-inch chains and 1¼-inch bolts. This boom will be secured to a timber sunk into the ground at the shore end and will rest against a buttress on the overflow dam. It will be supported by four crib piers 13 x 22 feet, the fronts of which are at a slight angle to the sides, so as to obstruct the flow as little as possible. (3) At a distance of 250 feet from the front of the main dam are placed two piers, 13 x 22 feet, with ice breaking faces and constructed of 12 x 12-inch timbers.

Booms constructed of two 12 x 12 timbers, with bolt and chain fastenings, are secured to these and inclined to the waste weir entrance, forming a complete protection against any trash which may be allowed to pass the second boom (if the water level ever falls below the top of the overflow), and against ice which may form in the head race up to the second boom. All the boom piers are provided with suitable snubbing posts capped with galvanized iron and are filled with stone.

TURBINES.

Each flume will contain (Fig. 9) two special 54-inch Victor turbines, a total of 72, which are connected in sets of six turbines to twelve generators, four in each power-house. These wheels are set vertically on 3-inch plank flooring, and will develop 200 h.p. each, under a 11-foot head, a total of 14,400 h.p. Under this head they will run at 64 revolutions per minute and discharge 12,000 cubic feet of water per minute.

Each set of six wheels is connected by bevel core gears to a common jack-shaft, and this transmits their power at a speed of 175 revolutions per minute to a 3-phase generator of 750 K.W. guaranteed to stand 25 per cent. overload. The speed is regulated by a governor guaranteed to control the speed within two per cent. from no load to full load.

The gears and shaftings are supported on heavy cast-iron saddles resting on 15-inch I-beam girders, two beams to a girder, bolted at the ends to the piers by bolts running 24 inches into the piers. These girders also support by stirrups 8-inch I-beams on which the gear-shed flooring of 3-inch plank lies. This flooring is so arranged that the stop logs may be taken out and hatches are hinged over the space required to take out the head gates. At the back and front of the gear shed beyond the ends of the 8-inch floor beams the flooring rests on 12-inch timbers.

GEAR SHEDS.

The gear sheds (Fig. 14) are of steel frame with peak roof, Fink truss design. The uprights at each pier are lattice columns and are arranged to carry 21-inch I-beams on which a 25-ton hand power crane will run from end to end of the building, a distance of 975 feet. The distance from the floor to the eaves of the shed is 25 feet, to the peak 36 feet, and the distance between uprights, or the clear width of the shed inside, is 38 feet. A wooden sheathing of studding and planking will be run along the sides and covered with corrugated iron. Between the roof trusses, which are 21 feet 6 inches apart, 6 x 12 inch purlines will be laid. Over these two

layers of 1¼-inch boards will be laid, with two-ply 10-ounce roofing felt between, and the whole will be covered with four-ply plastic asphalt.

POWER HOUSES.

The power houses (Figs. 9 and 14) are built of steel frame, and the roof is of special design, the distance to the peak being 50 feet; 12-inch brick walls are carried all around the front, back and sides, except where the travelling crane passes through, above which a wooden partition will be run up with doors to close when the crane is not in use. Loads carried by the crane will pass through openings 12 feet wide on each side. The inside dimensions of the power houses are 64 x 44 feet. The flooring is of concrete covered with 1-inch slate to prevent dust rising from the concrete.

The generator foundations form the flooring as far back as they go; beyond them 12-inch I-beams are laid with terra cotta between, over which three inches of concrete and slate is laid. The flooring is given a pitch of ¼-inch to the foot for drainage. A hatchway 4 x 5 feet, and a spiral stairway is provided for access to the vault-like recess below the generators and pipes, to carry the cables to the switchboard, etc., run through the floor.

On the massive arched foundations are to be placed the generators; these will stand 11 feet high above the floor, have a base 15½ x 10 feet, and weigh about 45 tons each. They are held down by four 2¼-inch bolts 12 feet long, which can be readily taken out if required. Two stone blocks, 30 x 24 inches x 16 feet, are placed under the generators, one at each side. Two 4-pole exciters of 75 K.W. capacity are placed at the down-stream end of the power house. They are belted to the main shaft and will each serve two generators, but either of them is capable of exciting four generators. The bases of the exciters are securely bolted down to the I-beams on which they rest.

SWITCHBOARD.

The switchboard arrangements are not yet completed, but they will probably stand on an elevated structure at the down-stream end of the power-houses; they will be built entirely of marble and finished to an ornamental design.

Power will be transmitted to the distributing station in Montreal, a distance of six miles, at a pressure of 4,400 volts. This will be carried by 36 No. 0 copper wires strung on double petticoated insulators on six cross arms. The poles are of lattice steel work set 6 feet into concrete, and are placed 100 feet apart. From this station the power will be distributed throughout the city in underground conduits.

The capital stock of the Lachine Rapids & Hydraulic Land Company is $2,000,000. The officers of the company are: President, G. B. Burland; vice-president, T. Pringle; managing director, W. McLea Walbank; directors, E. Kirk Green, Peter Lyall and S. Carsley, of Montreal, and Alexander Fraser, of Ottawa. The engineers of the work are Messrs. T. Pringle & Son, and W. McLea Walbank, of Montreal, and Dr. Cary T. Hutchinson, Postal Telegraph Building, New York city, is in charge of the electrical department of the work. The contractors for excavation, masonry and cribwork were Wm. Davis & Sons, Ottawa; for turbines, shafting, gears, etc., the Stillwell-Bierce & Smith-Vaile Company, Dayton, O.; for electric machinery, the Canadian General Electric Co., Peterboro, Ont., and for steel construction and pole line, the Dominion Bridge Company, Montreal.

There have been used in the work 8,700 cubic yards of concrete, 6,000 cubic yards of masonry, and 2,900,000 feet B.M. of timber; 225,000 cubic yards of rock have been excavated.

The writer wishes to acknowledge his indebtedness to Messrs. T. Pringle & Son, from whom the detail drawings used in the preparation of this article were obtained.

For THE CANADIAN ENGINEER.

THE OTTAWA WATERWAY TO THE GREAT LAKES

BY A. J. FORWARD, OTTAWA.

(Concluded.)

Besides ore, however, there must be taken into account flux fuel, labor and transportation facilities. The city of Ottawa is built on limestone. On this point Mr. Birkenbine's report says:

"Limestone is abundant in the territory about Ottawa, and the Geological Survey officers state that both limestone and dolomite, as well as intermediate qualities of magnesian limestone, are obtainable. It is therefore possible to find either near the mines or near the furnace location an abundance of limestone for flux."

Facilities for obtaining and cost of fuel are, perhaps, the two most important elements. To quote Mr. Birkenbine again:

"To appreciate the position of Ottawa to a fuel supply, we may first consider its position in relation to the anthracite coal region of Pennsylvania. Taking Scranton as a centre, the circumference of a circle which passes through Ottawa, would also pass through or close to Cleveland, Ohio; London, Ont., and Rouse's Point, N.Y. As the railroad connections between Scranton and Ottawa are nearly direct, and as there is no duty on anthracite coal, this fuel should be delivered in Ottawa at approximately the same all-rail rates that prevail to the other points named. Very satisfactory coke for furnace use is now being produced in Pennsylvania, 100 miles nearer Ottawa than Connellsville, and the use of such fuel would give Ottawa an advantage of fully 100 miles over Chicago in distance."

Pennsylvania coal can be brought in by direct all-rail routes as stated, or via the Rideau Canal. Nova Scotia coal comes as far as Montreal in considerable quantity, there entering into competition with American coal. It could be brought to Ottawa at very slightly increased cost. Within eight or ten miles of the city are extensive peat bogs, which might be successfully used for coking purposes. Peat also occurs along the line of the Rideau Canal, and in the vicinity of Caledonia Springs, close to the Ottawa River. And in case of the location of furnaces here it would be worth while to inquire into the value of the refuse from the various saw-mills, which now is allowed to pollute the river. This might be used as a fuel when converted into gas, as at present practised in Norway and Sweden in the manufacture of iron of the highest quality. The location is also one of the most favorable in Canada for the manufacture of charcoal iron, for from the forests of the great Laurentian area might be obtained supplies of charcoal for years to come. Labor is plentiful, cheap, and of good quality. With waterways south, east and west, and railways radiating in all directions, and located near the convergence of all the great trunk lines of Canada which have been or may be built, Ottawa would be in an ideal situation to distribute the manufactured product. To the western market she would be as near by water as Hamilton, and 250 miles nearer to Montreal. The Canadian Pacific and Ontario railroads running north to the Ottawa River, could be supplied to the best advantage. With cheap iron, cheap lumber, cheap water-power, cheap electricity, and cheap transportation, manufactures would spring up in the Ottawa Valley, and would create markets. And clearly, all development of mineral and forest resources to the northward, as well as all settlement in that direction, will have the Ottawa River as their base of supplies in the future as in the past.

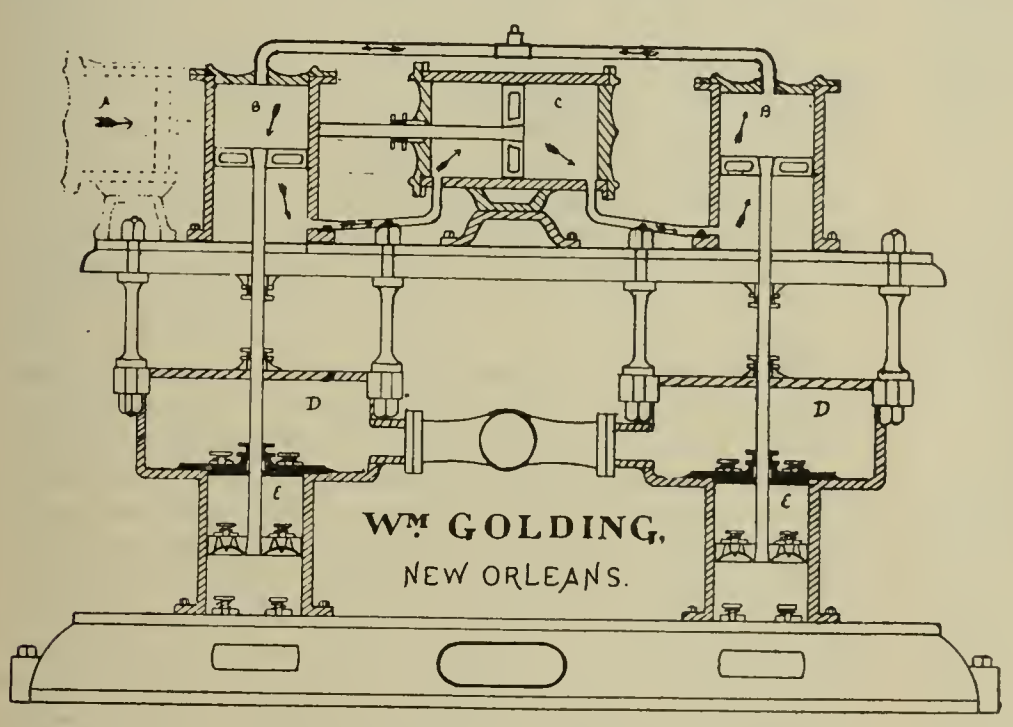
In these days of Deep-waterways Conventions we hear much said of the enormous traffic of the great lakes. It is interesting to note that nearly 75 per cent. of that is composed of lumber and iron. In view of that fact, and considering that these two products constitute our most abundant and valuable resources, residents of the Ottawa valley may be permitted to question the sweeping assertion that all Canadian routes to the seaboard are disqualified "because they run through a district that can furnish but very little freight in either direction." We have iron enough to supply the continent. W. C. Edwards, M.P., one of the most prominent lumbermen in Canada, referring to the extensive forest area, and commenting on the methods of Canadian lumbermen, recently expressed the opinion, from his seat in the House of Commons, that a very large output of lumber from this region might be continued indefinitely, if proper measures for forest conservation are adopted. Unless there is some material error as to the extent and nature of our resources, or as to the functions and effect of waterways in developing these, there appears to be ground for asserting that the opening of the navigation of the Ottawa River to the great lakes will accomplish more for the advancement of Eastern Canada than any public work in our history, not excepting the Canadian Pacific Railway. Its beneficial effects in aiding the settlement of the North-West, as well as the northern districts of Ontario and Western Quebec, are beyond the scope of this paper.

THE report of the investigation commission appointed by the Dominion Government to inquire into the affairs of the Kingston Penitentiary reported that the sewage works of the prison were badly planned, improperly constructed, faultily equipped, inefficient in operation, extravagant to maintain, and revolting to attend. The engineer is not responsible for the design of the present system, but he is not blameless as regards its equipment and operation. In dealing with the water supply for prison purposes, there appears to have been the grossest incompetency on the part of the engineer. The heating system is said to be operated without regard to the favorable conditions which exist to secure economy in expenditure.

STEAM ROAD ROLLER

The Good Roads Machinery Co. of Hamilton have been appointed agents in Canada for J. & H. McLaren, of Leeds, proprietors of the McLaren patent steam road roller, which has obtained a high reputation in Great Britain. It is a modification of the Gold Medal Traction Engine made by the same firm, and like it, is noted for simplicity, efficiency, economy and durability. The McLaren roller is made in various sizes from 7 to 20 tons weight, and an average machine will compress over 2,000 square yards of 4-inch metaling in a day of 10 hours at a cost of $5 to $6, including coal, men's wages, interest on capital, wear and tear, etc. The front rollers are carried on a patent swivelling carriage, by which a fruitful source of breakage is avoided, and at the same time it admits of rolls of large diameter, which turn easily and accommodate themselves to inequalities of the road. The hind rollers are mounted on the main axle, and the gearing, which is of the best steel, is so arranged and the position and width of the wheel so adjusted that the pressure per foot of ground covered by the hind rollers is assimilated as closely as possible to the pressure on the ground covered by the front rollers.

The boilers are made of the best quality of steel plates throughout, tested by cold water to 240 lbs. for a working pressure (if required) of 140 lbs. on the square inch. All the plate edges are planed up true, and all rivets closed by powerful hydraulic machinery. The steel spur gearing is practically unbreakable. The rollers are cast of a specially hard mixture of cast-iron to avoid undue wear. They are cast several inches wider than actually required, the extra width being cut off in the lathe from the top (or "spongy") side of the casting, so that perfect solidity is ensured for the full width of the roll. Each roller is fitted with scrapers on both sides, and the engine is fitted with a water tank, coal box, water lifter for filling the tank from any convenient source of supply, injector for feeding the boiler, as well as a pump worked



by an eccentric on the crank-shaft. A powerful brake is fixed on the engine for working on steep ground, and all the working parts are thoroughly case-hardened. Each machine is fitted with a complete outfit such as firing tools, a pair of lamps, waterproof cover, and an assortment of working tools—hammer, cold chisels, screw keys, oil-can, etc., etc.

At a slight increase of cost the McLaren roller can be supplied on the compound principle, and it is claimed that these compound traction engines are the best proportioned and most economical on the market.

TARIFF CHANGES.

The tariff revisions brought down by the Government, May 25th, contain evidences of a careful desire to conserve the interests of the manufacturers wherever possible. In discussing the duties on mining machinery, to which THE CANADIAN ENGINEER took exception in our last issue, the Minister said:

"In the matter of mining machinery, in our tariff resolutions were included a class of mining machinery exclusively used for mining, and provided that it should be admitted duty free. Under the old tariff there was a clause of somewhat similar character, restricting it to kinds of machinery not made in Canada. We found difficulty in the interpretation of that clause, and we have found there would be difficulty in the interpretation of our new clause, owing to the uncertainty as to what is mining machinery exclusively.

"We have had interviews with gentlemen interested in the manufacture of mining machinery, and also with many people who use such machinery, and after very full discussion, we determined to place 25 per cent duty on certain articles of mining machinery, and to specify all the articles which we wished to make free. There are a few items of mining machinery which are made in Canada, and which are well made and satisfactory to mining people, and these classes will still have to pay 25 per cent. Then we place on the free list a large number of items which are desired by miners. Item 535 in the amended resolutions reads as follows: Mining, smelting and reducing machinery, viz.: Pressure or exhaust fans, rotary pressure blowers, coal cutting machines, except percussion coal cutters, coal heading machines, coal augers and rotary coal drills, core drills, miners' safety lamps, coal washing machinery, coke-making machinery, ore drying machinery, ore roasting machinery, electric or magnetic machines for separating or concentrating iron ores, blast furnace water jackets, converters for metallurgical processes in iron or copper, briquette making machines, ball grinding machines, copper plates, plated or not, machinery for extraction of precious metals by the chlorination or cyanide processes, monitors, giants and elevators for hydraulic mining, amalgam safes, automatic ore samplers, automatic feeders, jigs, classifiers, separators, retorts, buddles, vanners, mercury pumps, pyrometers, bullion furnaces, amalgam cleaners, gold mining slime tables, blast furnace blowing engines, wrought iron tubing, butt or lap-welded, threaded or coupled or not, not less than 2½ inches diameter, when imported for use exclusively in mining, smelting, reducing or refining."

Special concessions are made to some lines of metal manufacturers. The carriage-makers get considerable raw material free. Steel for toolmakers is reduced from 15 per cent. to 5 per cent. Scrap iron, which was $4 a ton under the old tariff and was reduced to $1.50, is further reduced to $1. Steel ingots and billets are brought down from $4 a ton to $2 a ton. Structural iron is reduced from 15 per cent. to 10 per cent. Iron bridges are increased from 30 per cent. to 35 per cent.

TWIN PUMP.

The Twin Pump here depicted is believed by its inventor, Wm. Golding, C.E., New Orleans, to have a new system of actuation. Chambers *B C B* are filled with water. Steam cylinder *A*, shown in dotted lines on left upper corner of sketch, actuates the piston in chamber *C*, forcing the water into chamber *B*, under the piston: the water above the piston passes through pipe *E* to chamber *B* on opposite side, in the direction indicated by the arrows. The return stroke of the steam piston reverses the motion, thus causing the pump pistons to rise and fall with absolute certainty. There are many services for which this combination will have preference over all other movements, notably for air pumps and for moving large quantities of water; for drainage and for irrigation, where minimum first cost and cost of transportation and installation are important items.

ACETYLENE LIGHT FOR MAGIC LANTERNS.

Editor CANADIAN ENGINEER.

SIR,—Within please find one dollar for another year's subscription for your valuable paper. I find much good information in it. While reading your account of Mr. Willson's calcic carbide works, of St. Catharines, I was forcibly struck with the idea of lighting my magic lanterns with the acetylene light. I would like you to give your readers information how to generate, and what to get to produce the quantity and cost for a sufficient light for a small house where there are now three or four gas lights. Yours kindly,

P. T. TROWERN,
Chief Engineer Asylum for Insane, Toronto.

[A description of the Niagara Falls acetylene gas machine appeared in our April number, and that apparatus, among others, is a serviceable one for the production of the acetylene light. The carbide and acetylene works operated by Mr. Willson at Merritton now ship the carbide in conveniently small tanks made of galvanized iron, each holding 100 lbs. of the dry carbide, which, we understand, is sold at $4 per tank, or $80 per ton. On this basis it is estimated that the gas produced by the carbide is equal to coal or water gas at 60 cents per 1,000 feet. Mr. Maundell, of Woodstock, has experimented with the following result: 1 lb. of carbide will produce five feet of gas, which will yield 240 to 250 candle power, at a cost of four cents. Thus 1¼ feet of acetylene gas will give

about 60 candle power for one hour at a cost of one cent.; while with ordinary gas, at $1 per 1,000 feet, 10 feet will yield 25 to 35 candle power for one hour at a cost of one cent, or about half the quantity of light. An improved burner for acetylene gas has been brought out in the United States, making a more economical light and giving better distribution than those heretofore in use, which are different to the ordinary gas burner, though attachable on the same pipe. The method of generating is referred to in the February and April numbers.—Ed.]

PUMPING BY COMPRESSED AIR.

The Pohle Air Lift is a system of pumping water from artesian wells by means of compressed air without the use of any moving parts. Its advantages are claimed to be that it pumps larger quantities of water with greater economy and reliability. In addition sand or grit does not affect it, the water is purified and one air compressor (usually located in the engine room) will pump from any number of wells regardless of distance. Two properly proportioned pipes are placed in a well, the one an air pipe leading to the air compressor and connected with the other—the water discharge pipe—near its base, through what is known as the foot or end piece. The compressed air is forced through the air pipe into the foot piece and water pipe, and by its inherent expansive force, layers or pistons of air are formed in the water pipe, which lift and discharge the layers of water through the end of the water discharge pipe at the surface or tank. At the beginning of the operation, the water surface outside of the pipe and the water surface inside of the water pipe are at the same level; hence the vertical pressures per square inch are equal at the submerged end of the pipe, outside and inside As the compressed air is forced into the lower end of the water pipe, it forms alternate layers with the water, so that the pressure per square inch of the column thus made up of air and water, as it rises inside of the water pipe, is less than the pressure per square inch outside of the pipe. Owing to this difference of pressure, the water flows continually from the outside to within the water pipe by gravity, and its ascent through the pipe is free from shock, jar or noise of any kind. These air sections, or strata of compressed air, form water-tight bodies, which in their ascent in the act of pumping are said to permit no "slipping" or back-flow of water. As each air stratum progresses upwards to the spout, it expands on its way in proportion as the over-lying weight of water is diminished by its discharge, so that the air action which may have been, say 50 lbs. per square inch at first, will be only 1.74 lbs. when it underlies a water layer of four feet in length at the spout, until finally this air section when it lifts up and throws out this four feet of water, is of the same tension as the normal atmosphere.

One of the many advantages which are claimed for this system is that the water is aerated, and this is an important consideration, as is usually acknowledged, and Prof. Thos. M. Drown, of Lehigh University, recently stated that the success of filtration is largely dependent upon aeration. The Ingersoll-Sergeant Drill Co., 26 Cortland street, New York, which construct plants on this system, states that it is already in successful operation in a number of cities in the United States.

The annual report of the Minister of Railways and Canals shows that the number of miles of completed railway was 16,387, an increase during the year of 296 miles, besides 2 106 miles of siding. The number of miles laid with steel rails was 16,137. The number of miles in operation was 16,270. The paid-up capital amounted to $809,817,900, an increase of $5,177,341; the gross earnings to $50,545,569, an increase of $3,760,082, and the working expenses aggregated $35,042,655, an increase of $2,292,986, compared with those of the previous year, leaving the net earnings $15,502,914, an increase of $1,467,096. The number of passengers carried was 14,810,407, an increase of 822,827, and the freight amounted to 24,266,825 tons, an increase of 2,742,404 tons. The total number of miles run by trains was 44,500,692, an increase of 3,838,712. On the Intercolonial Railway system the loss on the year's operations was $55,187. The Windsor branch showed a profit of $20,085. The P.E.I. Railway showed a loss on the year's operations of $78,662 02. The Grand Trunk Railway carried 7,587,148 tons of freight, and the C.P.R., 4,576,632 tons. The number of passengers carried by the Grand Trunk was 5,077,671, and by the C.P.R, 3,036,619. The total gross earnings of the Grand Trunk amounted to $16,506,000, and of the C.P.R. to $20,175,000. The total net earnings were $4,962,000 for the G.T R., and $7,973,000 for the C.P.R. The passenger traffic yielded the C.P R. $4,759,000, and the Grand Trunk, $5,002,000. The G.T.R. had no passengers killed during the year.

LITERARY NOTES.

In 1894 a memorial was presented to the county council of Wentworth recommending that a prize be offered for a history of Wentworth. Acting on the memorial the council offered a premium of $100 for the best historical essay, and the prize was awarded to J. H. Smith, the inspector of public schools for the county. This has now been published, with some additions and illustrations, and those who may have the opportunity of reading this instructive pamphlet of 140 8vo. pages will heartily commend the judgment which awarded the palm to Mr. Smith. It is not commonly known that a white man entered the forests of Wentworth County as long ago as 1669. This was no other than La Salle, the intrepid French Canadian explorer, whose journeys are recorded by Galinn, one of the priests who accompanied him, and whose narrative is quoted from an interesting paper by B. E. Charlton, a former mayor of Hamilton. For the actual settlement of Wentworth we come down to about the beginning of the present century, and in that short time the settlement and development of the county—in population, wealth, education and in all that contributes to make a progressive and enlightened community—has been remarkable. In fertility of soil, wealth of orchards and gardens, charm of rural scenery, variety of agricultural products and intelligence of its inhabitants, Wentworth has become famous, and Mr. Smith's graphic sketch shows that it is also rich in historical records. Among these not the least to be proud of is the memorable battle of Stony Creek, in which a band of 704 British put to confusion and flight an American army of 3,500, and by this bold assault turned the tide of invasion from the whole province of Upper Canada. Mr. Smith's style is very pleasing, his language choice, and it is saying much for the value of his work that while dealing with local events, there are very few pages in his work which will not be both instructive and entertaining to readers who may have no personal interest in the county itself.

The address of George E. Drummond, Montreal, president of the Mining Institute of the Province of Quebec, on the history of the pig iron trade of 1896, read before the Institute at its last annual meeting, has been reprinted in pamphlet form. Mr. Drummond presents the claims of the producers of Canadian pig iron with his well-known ability and clearness, and gives, moreover, a very instructive review of the iron trade of Great Britain and the U. S. during the past year. While the large consumption of pig iron in Great Britain seems to show sunshine, Mr. Drummond sees clouds ahead there. A large part of the demand in Britain was for war office and navy yard contracts, while the large imports of American pig iron, taken in conjunction with the decreased exports of British iron products, indicate impending changes of great moment The combined output from Scotland, Cumberland and Furness district, and the Cleveland district of Britain, last year was 5,624,573 tons, or 601,622 tons over 1895; but this increase was only in the home trade, and the exports to France, Russia, Spain Portugal and Canada all showed a decline. Very little Scotch iron came to Canada, American pig being so much cheaper in this market—the difference being fully $4 per ton. It is estimated that only 2,454 tons of Scotch pig came to Canada last year, against 22,913 tons in 1892. Furthermore, the home mines in Great Britain are beginning to show signs of depletion, the "black band" being nearly worked out, and British consumers are seeking new mines in Spain to take the place of the Bilboa mines, which are also being worked out. The price of Spanish ore will therefore increase relatively and this will make American competition a factor all the more prominent as time goes on. The American production of pig iron in 1896 was 8,623,127 tons, which, though it showed a decrease of 9 per cent. since 1895, was still ahead of all other countries in the world Mr. Drummond computes the production of pig iron in Canada in 1896 at 61,839 tons, being an increase of 41 per cent. over 1895. This does not include the returns from Drummondville, Que., which had not been received. There was also produced 12,964 tons of Canadian steel, 1,243 tons of forgings, and 4,575 tons of puddled bars, etc. To produce this quantity the following Canadian materials were used: Ore, 82,705 tons; coal, 114,554 tons; coke, 46,219 tons; charcoal, 557,400 bushels, and limestone, 34,946 tons. Of foreign materials there was used at the Hamilton Blast Furnace Co.: American ore, 32,025 tons; or about 72½ per cent. of their total consumption; and of American coke, 30,217 tons. The Nova Scotia Steel Co.'s works used 7,269 tons of Newfoundland ore, 3,164 tons of Spanish ore; while the Canada Iron Furnace Co. (Radnor Forges) and the Londonderry Iron Co. used solely Canadian material. In the course of this able paper Mr. Drummond points out that in point of labor the worst kind of competition the Canadian iron producers have to contend with is the negro and convict labor of the Southern States. The latter is

"virtually a system of legalized slavery," the state prisoners being auctioned off to mining companies who pen the prisoners in the mining camps, and get the most out of them, paying the State so much per year per man. Mr. Drummond fairly argues that some sort of protection ought to be had against such a system of labor. Not the least interesting feature of Mr. Drummond's pamphlet is the copy of a petition signed by over 1,400 farmers, miners, merchants and others of the counties of Joliette, Vaudreuil, Nicolet and St. Maurice, addressed to the Dominion Government in behalf of a policy of encouragement to the iron industry of those regions.

The publishers of the *Canadian Manufacturer* are showing commendable enterprise in preparing a special issue containing the new tariffs of Canada and the United States. To this will be added the tariff of Great Britain—for, though Britain is a free trade country, its tariff of dutiable articles makes a longer list than most people imagine—and the whole will make a very valuable paper for reference purposes. This special number will be sold at 10 cents, and will be issued as soon as the Canadian and American tariffs are settled.

The magnitude of the paper and wood pulp industries of this continent are well set forth in a special number of the *Paper Mill and Wood Pulp News*, recently issued by L. D. Post, 21-23 Centre street, New York. This number contains 84 pages 12 x 16 inches, and the splendid machinery and appliances that now go to the equipment of the big paper mills are depicted in a fine series of photo-engravings. Mr. Post is to be congratulated on his enterprising paper. It is devoted to the various phases of the paper and pulp manufacture, and is published weekly.

"Notes on Copyright" is the title of a really valuable treatise on Canadian copyright by Richard T. Lancefield, the librarian of the Hamilton Public Library. Mr. Lancefield has made a study of this subject for several years, and he is the best authority on the subject in Canada to-day. The present work treats of copyright in general, and of the special features of the copyright law of Canada, of Great Britain, and of the United States. A chapter is given to the question of royalty, and the Canadian Acts of 1872 and 1875 are defined, and the text of the suspended Act of 1889 given. The provisions of the Berne Convention are set forth, and much other information presented in a clear and understandable form, and the forms of application for copyright are appended. Altogether Mr. Lancefield has presented the first complete text book on Canadian copyright, and it is published at the nominal price of 30 cents per copy.

"Railway Technical Vocabulary of French, English and United States Terms," by Lucien Serraillier, has just been issued from the press of Whittaker & Co, 2 White Hart street, Paternoster Square, London, E.C. Price, 7s. 6d. As the author states in the preface, railway terms are comparatively modern; many have been coined independently in each country as required by the progressive development of railways, by the improvement effected in railway plant and appliances, and by the adoption of new methods, constructive and administrative. Some international nomenclature is needed which shall give the technical equivalents of these terms in each language, and thus save the time and labor often evolved in looking up special text-books for any terms which may occur either in foreign technical literature, or in the course of the annually increasing business dealings between home and foreign railways. It is to be hoped also that some understanding may ultimately be arrived at by which either a process, operation, or appliance shall be known by one name only in each language, so as to avoid the confusion and uncertainty which often arise when various expressions denoting the same object are adopted by different railways in the same country.

CATALOGUES.

A. B. Jardine & Co., Hespeler, Ont., have placed before the trade a handsome new catalogue of their machinists' tops, tube expanders and blacksmiths' tools.

Water Pumped by Compressed Air, is the title of a most interesting illustrated pamphlet which the Ingersoll-Seargeant Drill Co, 26 Cortlandt street, New York, is sending to its friends and those interested in the development of compressed air as an industrial force. A description of the Pohle air lift system will be found in another column.

The Montreal Pipe Foundry Co., Ltd., has issued a neat pocket-sized catalogue, which contains in addition to tables showing pressure of water in pounds per square inch for different heads, the thickness of metal and weight per length for different sizes of pipe under various heads of water, specific gravities and weight of a cubic foot of various substances, etc., and a number of pages for memoranda, which make it a very useful companion.

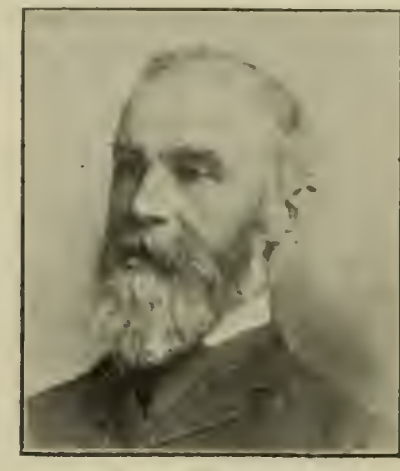
W. S. Rockwell & Co., furnace engineers, 26 Cortlandt street, New York, are sending their '97 catalogue to the trade in Canada, showing the advantages of the Rockwell improved duplex system for burning fuel oil.

The Clarence E. Van Auken Co. of Chicago, illustrates its catalogue of steam specialties by photo-engravings of some of the finest buildings in the United States, in the heating of which the apparatus manufactured by this firm is employed.

The full page illustration in the catalogue issued by M. Beatty & Sons, Welland, Ont., gives an idea of the variety and size of the contractors' and mining machinery which is turned out by this enterprising firm. Steam dredges, ditchers, derricks, shovels, hoisting engines, horse-power hoisters, hoisting machines, stone derrick irons, gang stone saws, centrifugal pumps and other machinery is shown, much of it as it appears in actual operation in the execution of contracts.

THE LATE ALAN MACDOUGALL, C.E.

A serious loss was sustained by the engineering profession of Canada by the death of Alan MacDougall, C.E., which took place at Exmouth, Devon, England, April 23rd. Mr. McDougall was the third son of the late Col. MacDougall, of Edinburgh, Scotland, where he was born and received his education. He served his pupilage under Charles Jopp, consulting engineer of the North British Railway Company, under whom he had charge of several important works, especially on the Dalkeith Branch of the N.B. Railway. He came to Canada twenty five years ago, and was employed on preliminary surveys and construction of the first sixty miles of the narrow gauge railways, as chief assistant under Edmund Wragge, consulting engineer, leaving the road before completion. He had charge of construction of the North Grey branch of the Northern Railway. He was for four years in the Department of Public Works, in charge of harbor and river improvements on the upper lakes and lower St. Lawrence, until in the crisis of 1877 the staff was disbanded. Going to Scotland, he obtained employment



ALAN MACDUGALL, C.E.

on the North British Railway, as chief indoor assistant to the chief engineer; had charge of the survey and draughting department. Returning to Canada in 1882, he was a divisional engineer on construction of Canadian Pacific Railway for one season, after which he devoted himself to sanitary science, and commenced practice in Toronto, where he worked up an extensive practice in every branch of sanitary engineering and science. His opinions have been sought by municipalities in every part of the Dominion on water-works, drainage, and other health questions, and also in Newfoundland, where he was offered the city engineership of St. John's, which he was unable to accept. Before leaving he received the thanks of the St. John's Board of Health for his services rendered during an outbreak of diphtheria. Among the numerous places he has advised on sewage and water supply may be mentioned: Stratford, St. Catharines, Port Arthur, Belleville, Peterboro, Goderich, Ont., and Brandon, Calgary in the North-West, and Vancouver, B.C.

Mr. MacDougall was married to a daughter of the late Dr. McCaul, in his lifetime president of the University of Toronto, and leaves a widow and four children, two sons and two daughters.

THE Gatineau Valley and the Pontiac and Pacific Junction Railway Companies are desirous of extending their lines into and through the city of Hull to the bank of the Ottawa River, to erect a commodious station at the junction of the railways, and to build a workshop for the use of both roads. An application has been made to the Hull city council, asking for the grant of these rights.

IRRIGATION IN THE NORTH-WEST TERRITORIES.*

BY WM. PEARCE, DOM. SUPT. MINES, CALGARY, N.W.T.

The object sought to be attained by sending your society an article on irrigation in the North-West Territories, is not so much that the climate of Ontario is such that the subject is one of considerable interest to many in that Province, though one who has observed the beneficial effects of irrigation will unhesitatingly assert that in very many localities, and in the majority of seasons, irrigation, to a certain extent, would be beneficial and highly profitable; nor does he require the gift of prophecy to foretell that within the life of the present generation it will be practised to a very much greater extent in the humid districts than even the enthusiasts on the subject anticipate. Before leaving this branch of the subject it may not be out of place to observe that few, if any, that were reared in a humid clime, and afterwards lived in an arid or semi-arid one, where irrigation was necessary, but were impressed with the neglected opportunities in irrigation in the humid portions. Particularly is this applicable to gardening and the growth of trees. Further, you in Ontario irrigate to a much greater extent than you imagine. Every gardener, in watering his plants, shrubs and trees, sprinkling his lawn, etc., is engaged in irrigation.

Writers of good repute have asserted that the Garden of Eden was irrigated, and that assertion can be fairly if not fully proven, and slight reflection will convince anyone that all the ancient civilizations existed wholly in irrigated territory. The subject is not new, but older than the earliest records, so that no apology is necessary because of its newness.

There is any amount of scope for the inventive genius intelligently applied by the members of this association on lines for which your training has to a very considerable extent fitted you, and in which your tastes will no doubt find the most congenial employments, viz., in the solution of devices for accurate measurements of water and the division thereof. Although inventive genius of a high order has been brought to bear on these contrivances for centuries, they are far from arriving at anything like the accuracy desirable. This, to those who have not given the subject any attention, will no doubt seem surprising, but an investigation thereof will demonstrate its truth, and the attempt of its solution will be found most interesting even should the results not prove successful.

Another branch of the subject equally interesting and valuable viz., designs for dams for diversions of water from the beds of the streams, or for creating reservoirs for storage thereof, head gates, and other gates required along the systems, falls or drops for water which are necessary to a greater or less extent on all systems of any size, spillways or checks necessary to prevent the breaking of banks, etc., arising from local storms or cloud bursts, flumes of various designs for carrying water over or around obstacles of various kinds, tunnels, bridges, culverts, etc., the best manner of making the topographical surveys necessary, not only to obtain the information requisite to design the minor ditches or canals of any system, so that economy and thoroughness in their construction may be attained; also the same information over a lesser area required for the purpose of the distribution and application of the water when delivered at some point on or near to the land on which it is to be applied. Implements for levelling the land so that the water can be cheaply and thoroughly applied thereon. It may seem strange that after water has been applied on land for centuries that there should be room for ingenuity or a material improvement in this line, but such is the case; the conditions vary so that what may be suitable in one case may not be applicable in another, and with us where the products from irrigation must be sold at best at moderate prices, there is necessity for the greatest economy on the lines mentioned.

Anyone who may think this subject an uninteresting one will find himself agreeably astonished. Running water has a fascination for all.

In 1894 the Dominion Government instituted surveys, gauging of streams and collection of data necessary to ascertain the amount of water available, and those portions of the territories on which it could be best applied, also for the location of sites for the storage of water; this last has a very important bearing, as has also the conservation of forest areas.

The experience of other countries, particularly that of our neighbors to the south, has demonstrated that no time is to be lost in making the reservations for the purpose indicated—as settlement, the construction of roads and railways have naturally occupied the points which are most vital in storage of water, if such is to be stored at the minimum of cost and at the best points. At one point in the Rio Grande, the United States Geological Survey report that the creation of a reservoir at the best point, in fact the only one, will necessitate the reconstruction of a railway, which would involve the outlay of hundreds of thousands of dollars; this might have been obviated without material cost to said railway had the reservation been made before the construction thereof.

Up to the close of the season of 1896 the Canadian Irrigation Surveys had been extended over a considerable area. The complete work comprises 1,296 miles of line levels, 3,811 square miles of contour topographical surveys, and 44 detailed surveys of reservoir sites. In addition to this some 223 miles of location have been completed for proposed irrigation canals, some of which are of considerable magnitude. The question of the water supply available for irrigation in the portion of the territories requiring irrigation has been examined into; 319 gaugings of streams have been completed, and the discharge of a large number of springs, and the volume of numerous lakes measured. The information needed in attacking the many complex problems connected with the flow of or storage of water has necessarily to be of an exact character, and the field work in connection with the irrigation surveys has to be carefully performed, so that in some instances great rapidity is not attainable; however it will be seen from the above statement that good progress in this important work has been made.

There are now in operation in the Territories 157 irrigation canals and ditches supplying water to areas varying from 10 acres to 10,000 acres. The total area under ditch and capable of being irrigated therefrom comprises some 140,000 acres, of which only a portion is as yet being supplied with water, but this portion is being rapidly extended as fast as the land can be prepared to receive the water, and from present indications, and with fair encouragement, the growth of irrigation will undoubtedly be rapid.

Very full reports of what has been accomplished, illustrated with maps, plates and diagrams, have been issued by the Department of the Interior for the years 1894 and 1895, and the one for the past season will shortly be forthcoming, and any member of the association whose interest in this subject is aroused would probably obtain copies thereof by application to the secretary of the Department of the Interior.

The cost of irrigation in the United States has been $8 15 per acre for preparing the land and $12.12 additional. With us the cost will be considerably less.

The district of country which requires irrigation may be described as follows:

Bounded on the south by the international boundary; on the west by the Rocky Mountains; the other boundary being described as follows: Commencing at the intersection of the international boundary by longitude 102° west, thence northwest to latitude 51° 30′ north, thence west to the Rocky Mountains, containing about 80,000 square miles or upwards of 50,000,000 acres.

Its elevation on the east averages about 1,600 feet above the sea, and the western boundary of the cultivable district about 4,000 feet.

The duty of water will be high, as there is always considerable rainfall and the subsoil being a heavy clay. It is estimated that with storage facilities, which can be economically constructed, there will be water enough for seven or eight millions of acres.

The problems in connection with the application of water will require the highest statesmanship, so that it may be so distributed that the irrigated portions may be as proportionately as possible distributed around the non-irrigated portion, so as to make the latter contribute to the maximum extent as pasturage in connection with the irrigated portion.

The best mode of settlement to be adopted in the arid or semi-arid areas, has also to be solved. To utilize this vast area and obtain the best results, is a goal of the highest importance. This area must be devoted largely, if not wholly, to pastoral pursuits, and it is probable that the greatest volume of dairy products attainable on any portion of this continent, possibly within the same area in the world, may be raised in the tract under discussion.

It required considerable persistency on the part of a few who took up and agitated this question, to prevail upon our legislators to provide the legislation necessary for this subject, but in 1894 the country was fortunate enough to have an Irrigation Act placed in our statutes. It is probable in working out this question many defects will be found in same. It is hoped, however, that it will not be so productive of litigation as the Drainage Act has proved in at least one province in Canada. As the defects are discovered, they can, it is anticipated, be remedied by amendments to the said act. With us in the Territories, fortunately, the control of both the water and the land are vested in the same authority; thus we will

*A paper read before the Association of Ontario Land Surveyors.

avoid the great weakness that has been met with, and has proved so fatal to such a large number of irrigation enterprises in the western United States. It has also been attempted, and it would seem successfully, to have the administration thereof under strong central control, thereby avoiding the rock which has frequently proved so fatal, viz., disputes and litigation. On no subject, even in connection with rich and valuable mines of the precious metals, has there been so much heart-burning litigation, and in some cases many lives have been sacrificed in disputes arising out of water for irrigation purposes. It would prove much too lengthy to attempt in this to explain fully the provisions of the Irrigation Act, whereby such disputes are thought to be avoided, the making the title to water as secure as to land or any other property, doing justice to the consumer as well as the one who supplies the water, providing a speedy, equitable and non-appealable decision regarding any and all controversies which may arise out of the construction and carrying on of irrigation. None of the very many technical points or problems arising out of this subject have been attempted. It would make it much too lengthy, and had best be left and be taken one by one by any members of this or kindred associations. There are dozens of problems which each in itself would justify the production of a paper sufficiently lengthy, interesting and valuable to claim your attention at any one session.

He who makes a hobby of any subject cannot understand why his theme has not the interest to others that it has to himself, and it may be that to many of you this effusion may appear dry and uninteresting (it is at all events not a dry subject). But this promise can be safely given you, that at least 999 out of every thousand who take the trouble to enquire into this subject will be interested, and a goodly percentage will be as great enthusiasts as the writer. This is not a reckless assertion, but one fully borne out by experience. If even to a very small percentage of you an interest in this is aroused, the writer will be highly gratified and a thousand-fold repaid for the slight trouble taken.

ASSOCIATION CANADIENNE DE SECOURS MUTUELS DES INGENIEURS-MECANICIENS.

The Mechanical Engineers' Society of the Province of Quebec, was formed in 1894. The object of the association is not only to insure for its members benefits in case of sickness or in case of death, but also to give them the technical instruction so necessary in our days. These lectures are given semi-monthly by outside specialists, or by members of the union. By an intelligent administration this society, though having paid large sums of money to sick members, has to-day a surplus a good deal more than some older societies. The election of its officers for the year 1897 took place on the 20th April, with the following results: President, E. F. Valiquet; 1st vice-president, H. Beauchamp; 2nd vice-president, M. Guimond; treasurer, W. Gendron; financial secretary, E Leroyer; recording secretary, A. Bélair; assistant recording secretary, Jos. Gingras; corresponding secretary, A. Tessier; introductor, A. Habig; door-keeper, O. Tontaine; trustees, M. U. Lessard (president), E. Brisbois, A. Provost, J. Langevin, F. Lavigne, N. Depatie, Jos. Verdon; delegates to Central Council, Brisbois, Guimond; examiners, R. Drouin, E. F. Valiquet, H. Denis.

From a photograph by J. A. Dumas.

M. E. F. VALIQUET,

President of the General Association Canadienne de Secours Mutuels des Ingénieurs-Mécaniciens de la Province de Québec.

At a special meeting on the 4th of May, the ex-president, R Drouin, installed the new officers There in a short speech President E. F. Valiquet gave Ex President R Drouin a well-deserved compliment for his administration, and thanked him for his services to the association We publish above the portrait of the new president and vice-president.

Mr Valiquet is an employee of Rutherford & Sons, Attwater ave., Montreal, saw mills, as chief mechanical engineer, for the last five years.

M. HENRI BEAUCHAMP,

1er Vice-Président de l'Association Canadienne de Secours Mutuels des Ingénieurs Mécaniciens de la Province de Québec.

BEFORE THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The following abstracts of papers were prepared by members of the C.S.C.E., and read at a recent meeting.

Water-Power—Its Generation and Transmission *

BY SAMUEL WEBBER, CHARLESTOWN, N.H.

The author arrives at the conclusion that it is practically possible to store and secure for power about one-third of the total annual rainfall. This rainfall he reckons at 42 inches as a fair average for the larger part of the United States east of Kansas and Nebraska, amounting therefore to about 3 cubic feet per second per square mile of catchment area. One-third of this or 1 cubic foot per second per square mile of drainage surface is therefore the supply which can usually, by the aid of storage, be relied upon.

A sketch of the evolution of the modern turbine is then given, the credit of inventing the inward and downward combined flow turbine, which is the exemplar of all modern American turbines, being given to A. M. Swain, a mechanic who had been employed at the Lowell machine shops in the construction of the Boyden and Francis wheels. The result of this change from the Founeyvon type is to produce turbines of equal power in one-half the space and at one-fifth the cost.

The first cost of turbine installations is discussed and itemized for several plants, and is shown to vary from $50 to $100 per horse-power. The cost of water power per horse-power per annum is estimated in three instances at $8.64, $10 and $11.05; and is stated to be generally covered by the figure $15 per annum per horse-power.

In the discussion the credit for putting in the first pair of turbines coupled together on a horizontal axis is given to Emile Geyelin, of Philadelphia.

Water Power of Caratunk Falls, Kennebec River, Maine.†

BY SAMUEL M'ELROY, NEW YORK CITY.

The river basin is of about 5,917 square miles area, of which 3,800 square miles are forest, and 450 square miles are lakes and ponds, 311 in number. (Moosehead Lake alone has an area of 120 square miles.) Mean summer temperature 61° F. to 67° F., winter do. 19° F. With a large snow fall the thaw of the lower layers maintains the winter stream flow; and in spring the dangerous freshets of milder climates are delayed until the ice is, as a rule, brittle.

The Caratunk falls have large natural pondage above and below the falls, whose cascade has a natural fall of 28 ft.

Annual rainfall 44.5 inches (1839 to 1888), maximum 45".6 (1887), minimum 33".7 (1860).

There was no time to make a continuous gauge of the river; but from experience on this and other rivers a safe present plant outlay for 5,000 horse-power was determined upon.

The lowest permissible flow is discussed for various rivers, special reference being made to the lessons to be learnt from the Lowell and Lawrence water powers. The rainfall for 50 years of the Kennebec basin is analyzed, and the conclusion is arrived at that the fall is good now for 5,000 horse-power, as above, and has a great prospective value as the timber supply diminishes, and allows the Moosehead Lake, now impounded for logging purposes, to become available for maintaining an equable flow in the summer.

The cost of dam, flume, head-gates, wheel pit, etc., was in this case $15 per horse-power for the 3,500-h.p. actually provided on the

*Trans. Am. Soc. Mech Eng., Vol. XVII., p. 41.
†Am Soc. Mech. Eng., Vol. XVII., 1896, p 58.

west side; cost of wheels for 3,000-h.p. about $9, or $24 in all. The fixed charges on this the author reckons at $5.24 per h.p. per annum.

For comparison the cost of a 3,000 horse-power steam plant in this pulp-mill (where no exhaust steam is used for other purposes) is calculated, and found to be $52.17 per h.p. per annum. (Coal $6 per ton.)

Reference is made to the commercial value of a water-power; that at Lowell with a 4,085 square mile basin being valued at $2,787,200; and at Lawrence with an area of 4,553 square miles, at $2,866,720.

Hundreds of feet of floating light wood frames are used in Maine in the races above the mills to promote ice formation, and prevent the production of anchor ice. At Caratunk the reach above the dam freezes for two miles up stream, with blue ice 24 inches thick, which effectually prevents the anchor ice from getting to the falls.

In the discussion Mr. W. S. Aldrich discusses curves of combined turbine and dynamo efficiency for various loads.

The Underpinning of Heavy Buildings.*

BY JULES BRENCHAUD.

The writer refers to the great difficulties experienced in preventing injury, by settlement of heavy buildings, when it is necessary to excavate and build on the immediate adjacent building site.

The specific case treated is of a building which was to be carried 30 feet (2 stories) below the street level, over half of which had to be made water-tight, as it was below water level. The total depth of foundation being 45 to 50 feet below the sidewalk, these foundations consisted of close-fitting rectangular pneumatic caissons all around the exterior of the new building site and cylindrical intermediate ones for columns.

As every square foot of the property had to be built upon, the problem was to pin the adjacent buildings up during caisson sinking and construction periods. This was accomplished by placing vertical cylindrical iron columns in slits in the walls, extending from the foundation upwards. These were founded at the bottom on rock or very hard hard-pan, and at their tops the bearings were spread out by transverse horizontal slits in the walls, in which were placed nests of I beams on top of the columns.

The cylindrical columns were 10″ to 30″ in dia., the smaller ones being forced down by a 60-ton hydraulic jack, in sections 5 feet long, at a time, to proper bearing; some also were partially sunk by water jet. The larger ones under the heavier building were sunk by compressed air, as neither the water jet nor jack would force them through a layer of hard-pan to the rock.

The larger columns were first made of cast iron, but after one becoming injured by forcing past a boulder, the rest were made of riveted steel sections.

These columns were filled, after sinking, with Portland cement concrete.

The writer then details several similar cases where the application has been successful, and concludes by stating that while this method is not (evidently) of universal application, it will be found the best means of transferring the load of an adjacent building to a lower foundation with a minimum of obstruction to the building site about to be used, also that as these underpinnings are left in place, there is no danger of that slight subsidence which takes place when other kinds of temporary underpinning are removed.

[This method is evidently expensive, and only applicable when the bearing soil is poor, *e.g.*, quicksand—and the necessity imperative; when necessary it would appear to be a very admirable one.]

Methods and Results of Stadia Surveying.

BY F. B. MALTBY.†

For good results from stadia surveying, both good workmanship and good equipment are necessary. The writer recommends for use a transit-theodolite having the same graduation on vertical and horizontal circles (preferably reading to 20″), with a telescope magnifying to not less than 30 diameters. Field of the telescope to be flat and as large as possible. Vernier of the vertical circle to be swung from the horizontal axis of the instrument, and to be provided with a good level, to keep its zero in position independent of the plate levels. Such instruments are not at present in common use. Rods to be of well seasoned white pine 5 inches wide, 12 feet long and ⅝ inch thick, shod with strap iron at each end, straps having hole in them to place over station nail. Rod to be well pointed, graduated symmetrically, and preferably after the pattern used by the Mississippi River Commission. The length of the rod divisions may be determined by trial so as to correspond with the wire interval of the instrument, or may be laid off to some standard of length. The last is perhaps preferable, as the average stadia constant can be determined with great accuracy by running over long lines under all conditions of weather and exposure, the exact length of such lines being previously determined by triangulation. Value of the stadia constant varies in practice according to description of work to be done. Usually it is from 100 to 125; with such constant the graduations on the rod should be meters or yards and tenths rather than feet, 3½ to 4 inches being the minimum graduation spot desirable in ordinary practice.

Party should consist of topographer, recorder, and as many rodmen and axemen as circumstances call for. Topographer can average 500 points observed in a day, and it is true economy to work the topographer and recorder up to their full capacity by supplying them with all the rodmen and axemen that they can keep busy. Topographical surveying is to define general features rather than precise points as land monuments, and care should be taken that the area covered should be taken in equal detail in all parts. To secure this, the writer advises the use of a small plotting board about 15″ x 20″, upon which a continuous plotting of the stations can be carried on to small scale as they are occupied, and the fact that all the area has been fully covered can be graphically demonstrated. The sheets are made to overlap in the usual manner, and are of great assistance in the final plotting. For reducing the observations, the Colby slide rule is recommended, and three reductions per minute are instanced as easily as possible with this apparatus.

The line of occupied stations is plotted by lat. and dep., or by distances and bearings from a printed circle on the paper. The latter is quicker but not so accurate as the former. For plotting the intermediate and side readings the Colby protractor is particularly recommended. About 3½ points plotted per minute is given as average work for two men.

Statements of the final errors of many stadia run lines are given, and the writer's opinion is given that a discrepancy of not more than 1 in 1,500 can be obtained in average work, and that this is considerably more accurate than ordinary chaining. Levels when the instrument is equipped with a level on the vernier arm of the vertical circle can be carried for all distances within 0.50 feet.

The cost of surveys made by stadia varies very greatly, and a few examples are given:—

City of Baltimore topographical work (including buildings, streets, alleys), etc., $1.50 per acre, 200 feet to 1 inch. City of St. Louis topography 73 cents per acre, 200 feet to 1 inch. Mississippi River Commission, 1,000 feet to 1 inch, including 5 feet contours, buildings, roads, fences, etc., 1891, $36 per square mile. Missouri River Commission, 1895, $31 per square mile; minor instances from 20 to 50 cts. per acre. In the discussion it is stated that the inaccuracies of stadia work are less than those due to plotting and expansion of paper under varying conditions, that attempts at minute accuracy only add to the difficulties and expense of the work, and that the best use is made of the method when the work is carried on, without regard to the optic conditions of the atmosphere, and reduced by a constant obtained by stadia measurements of triangulation lines.

The Liverpool Waterworks.*

G. F. DEACON, M. INST. C. E.

The Liverpool new water supply is taken from the Vyrnwy River in Wales, and the a queduct connecting Liverpool with the reservoir is about 76 miles long. It includes 4 tunnels, 6 railway crossings, 13 river crossings, and 6 canal crossings, the latter including the Manchester ship canal. These crossings are in most cases subways, though in some cases the aqueduct was carried overhead.

Lake Vyrnwy is said to be the largest artificial reservoir in Europe, its area being 1,121 acres, and its capacity 12,131 millions of gallons below sill of dam and above outlet to the aqueduct. The author states that the dam for impounding this lake is the first high masonry dam used in Great Britain, its extreme height from overflow to base of foundation being 144 feet. A carriage and footway 19 feet wide is carried along the crest of dam on masonry arches. The author states a novel feature of this dam is the employment of relief drains from the foundations emptying into a tunnel in the heart of the dam. The idea of these drains was to prevent the development of pressure due to invisible springs, which it was thought, when the reservoir was full, might accumulate to such an extent under the foundations as to be of importance as one of the forces to be considered having a tendency to overturn the dam.

To quote the author's words: "Along the base of each of the more important beds of rock, not within 15 feet of the faces of the

*Proc Am. Soc. C. E., Vol. XXII., Dec., 1896.

† Journal Assn. of Eng. Societies, Sept., 1896.

*Proceedings of the Inst. C. E., Vol. CXXVI.

dam, a drain was formed by the masonry between six inches and nine inches square, and from these drains funnels were carried up, in different vertical transverse planes of the dam, to above backwater level." There are 27 of these funnels in a length of 66 feet of the deepest part of the dam, which empty into a longitudinal tunnel 4 feet 3 inches by 2 feet 6 inches, from which a cross tunnel to face of dam serves as an outlet and for access to main tunnel.

The tunnel under the River Mersey was one of the most difficult parts of the work, and the author states was the first tunnel ever constructed by means of a shield, under a tidal or other river, through entirely loose material. This tunnel had a cast iron lining of nine feet interior diam., and it was driven through loose water bearing strata 51 feet below high water. Inside the tunnel was laid the aqueduct, consisting of two 32 in. diam pipes, of riveted steel plates. The author says the site for this tunnel was favorable for laying the pipes in the muddy bed of the river, but that parliamentary exigencies forced upon the corporation the construction of the tunnel, for which the site was the worst possible.

These water works were begun in July, 1881, finished July, 1892. The total cost has been about £2,300,000 for a supply of 14,000,000 gallons per diem, but the author claims it can be increased to about 40,000,000 gallons per diem for additional cost of £1,600,000.

Electric Flashes.

W. B. CLOSE is now manager of the Toronto Suburban Street Railway Company, Toronto Junction.

THE new Victoria Bridge will carry the wires which will bring electric power from Chambly to Montreal.

E. SLADE has gone into the electrical supply business, in Quebec, and will handle chiefly lighting fixtures.

IN Quebec the Lower Town Street Railway Company has sold its franchise to the new electric company for $20,000.

WORK is to be hurried on the Quebec street railway. An opening on the 22nd is what the management is working for.

THE Brantford Electric and Power Co. is now running its new turbines, which are capable of developing 600 horse-power each.

NIAGARA FALLS SOUTH, ONT., has granted a franchise to the Lundy's Lane Electric Railway to run over certain streets of the town.

THE agitation for an electric railway to connect St. Catharines and Beamsville, Ont., is going on, and there are prospects of success.

A. O. GRAYDON, C.E., city engineer, London, Ont., is one of the provisional directors of the Chatham City and Suburban Railway.

WM. SNIDER & Co., Waterloo, Ont., electric light, have commenced building their engine room. A 75 h. p. Corliss engine will run the dynamos.

IT is proposed to extend the London, Ont., Street Railway beyond the asylum for the Insane to Pottersburg, and also to connect the city with the town of Lucan.

A CORRESPONDENT of the St. Johns, Que., *News* says that the proposition for an electric railway from Montreal running through the Eastern Townships to Sherbrooke, is not taken seriously by the township people.

COATES, SON & Co., bankers, London, Eng., recently placed an issue of £50,000 of the Montreal Royal Electric Company's shares, there being more offers than were applied for in the company's circular. The issue price was 140.

THE Aylmer Electric and Manufacturing Company, Ltd., applies for an Ontario charter to supply heat, light and power by steam and electricity in Aylmer, Ont.; capital, $20,000; the incorporators are H. H. McDiarmid, D. C. Davis, J. Simpson, Aylmer; J. W. Campbell, W. H Irving, Toronto.

IT is probable that Hamilton, Ont., will appoint an electrical engineer as assistant to the city engineer, owing to the increasing share of the engineer's duties which have to do with that subject. G. Black, Hamilton, is favorably mentioned for the position.

F. E. HARVEY, doing business as the Citizens' Telephone Exchange, with office at Waterloo, Que., has assigned. The assets are placed at $11,000 to $12,000, and the liabilities at $6,000 to $7,000. The principal creditors are: C. E. Harvey, Waterloo, $2,600; E. T. Bank, $1,000; John Bradford, Granby, $1,000; W. N. Call, Waterloo, $850. C. E. Harvey is curator.

A TELEPHONE cable has been laid across the inlet between Moodyville and Vancouver, B.C., by the New Westminster and Burrard Inlet Telephone Company, under the supervision of H W Kent

HODGKINS & HOSHAL are building a factory, 40 x [illegible] feet, for the American Carborundum Co., Niagara Falls Ont., in which the company will begin the manufacture of its product by June 15th in order to hold its charter Sufficient power to carry on work on a small scale has been obtained from the electric light company

THE Consolidated Railway Company's systems in Victoria Vancouver and New Westminster, B.C., are now owned and operated by a new company formed for the purpose of acquiring them in London, England The new company, which is called the British Columbia Electric Railways Company, Limited, took possession on the 15th of April and are making a number of improvements.

JUDGMENT has been given in the first of the trials arising out of the tramway disaster at the Pointe Ellice bridge, Victoria, B.C., May, 1896, the jury deciding that the city was liable for the disaster. The plaintiff, Mrs Gordon, whose husband was killed, was awarded $10,000 damages; $7,000 to herself, $1,000 to the eldest son, $1,500 to the youngest child, and $500 to a step-son A number of other suits will follow.

THE longest electrical transmission plant in the Dominion of Canada was put in operation a few days ago near Three Rivers, Que. This plant was installed by the Royal Electric Company of Montreal, for the North Shore Power Co., and transmits 700 h p from Grand Chute, on the Batiscan River, a distance of 17 miles, to the city of Three Rivers, Que., where the power is used for arc and incandescent lighting, as well as for power. S.K.C. two-phase apparatus is used throughout. A full description of this long distance high voltage plant will be published very shortly.

THE Hamilton *Times* says recently of the Cataract Power Co. of Hamilton, Ont.: A company has been formed to take Lake Erie water from the new Welland Canal at Allanburgh and from the Chippewa River at Port Robinson, and turn it into Lake Ontario via DeCew's Falls, utilizing the water power of the falls to generate electricity, which will be conveyed to Hamilton to pump Lake Ontario water into the city, to run our street and suburban railways, to light the streets and to move the machinery in the factories. J. Patterson expects that he will have 5,000 horse-power available four months hence, and 50,000 to 60,000 horse-power at a later date.

THE Toronto Street Railway Co is celebrating the Queen's Jubilee, putting on the road 20 handsome open cars, to be known as "The Jubilee Set." Each car is 27 feet long, and 7 feet 6 inches wide, 6 feet longer than the present open cars The extra length will allow a space of four inches more between the seats, adding greatly to the passengers' comfort. The cars are painted white and gold, carry bicycle racks on the back, and have double steps at the sides. The latest style of motor made by the Canadian General Electric Co. is used, and each car will seat 70 passengers. Manager Wanklyn and Superintendent Gunn maintain that the "Jubilee Set" are the finest open cars on the continent.

THE Sherbrooke Gas and Water Co., Sherbrooke, Que., has recently made extensive additions and alterations in its plant: the station has been enlarged, and there have also been installed two additional water wheels. The electrical plant has been increased by one 180 K.W. and one 75 K.W., "S.K.C." two-phase generators, in addition to the 75 K.W., S.K.C. two-phase generator which was purchased about a year ago from the Royal Electric Company, and which makes the plant one of the most complete incandescent plants in the Dominion. The management of the company has installed a power circuit from the alternating two-phase apparatus, and are now serving power and light successfully from the same generators and lines.

THE Packard Electric Co., Ltd., St. Catharines, Ont., has rceently placed upon the market its type "L" transformers. These transformers are claimed to be unique in design, and their efficiency at all loads is guaranteed by the makers to be greater than that of any other. The Packard Co. will, at the request of any central station, conduct tests for core loss, copper losses, regulation and insulation, of their type "L" transformers in competition with those of any other make. It also guarantees these transformers not to increase over 40° in temperature after running full load for eight hours. The all day efficiency is very high. One unique feature of these transformers, which will appeal to the central station and their line men, is that they require but one cross-arm upon the pole, and do not require any separate hangers; the arrangement for hanging being permanently attached to the transformer.

ELECTRICITY is to be used for pumping water for irrigation purposes at Korachien, Egypt.

THE electric light by-law, recently voted on in Chatham, Ont., was defeated by a majority in all the five wards of the town.

THE Cataract Power Co., Hamilton, Ont., has received permission from the city council to erect poles. The city will collect $1.00 per pole from the company.

THE Rogers Electric Co., of London, Ont., are installing a 200-light plant in D. S. Perrin & Co.'s biscuit works in that city. The Goldie & McCulloch Co. of Galt are supplying the engine.

LA Compagnie Electrique de Saint Etienne de la Malbaie applies for a Quebec charter, with a total capital stock of $5,000, headquarters in the parish of St. Etienne de la Malbaie: to exercise the industry of electricity in all its branches. The incorporators are as follows: J. Warren, Pointe au Pic; H. Simard, P. Maltais, A. Larouche, J. Couturier, A. Guay, La Malbaie.

ACHILLE GAGNON & Co., Victoriaville, Que., who began in December last furnishing incandescent light to the towns of Victoriaville and Arthabaskaville, have found it necessary to increase their plant owing to the rapid increase in their lighting. They have ordered a 75 K.W., "S.K.C." two-phase alternator from the Royal Electric Company, Montreal, as it is their intention to furnish power as well as light from the same generator and circuit. Their first installation was single-phase alternating, but finding that they could also secure some power business during the day, they decided to operate their plant 24 hours per day, and for this purpose secured an "S.K.C." two-phase machine, from which they serve both lights and power.

THE Boiler Inspection and Insurance Company announces that its special service department has arranged to extend the advantages of competent and periodical inspection to electrical dynamos and motors. The services of a competent electrical engineer, R. A. Ross, have been secured as consulting engineer, and skilled inspectors will make careful and periodical inspections, and do whatever is necessary in order to keep the motor or dynamo in proper running order. The chief advantages to motor and dynamo users in such an arrangement are, that the risk of having the power supply stopped is greatly lessened through the frequency of inspection, and the annual cost of maintenance being a fixed amount can be better provided for.

THE Quebec Court of Appeal has given judgment in the case of the Bell Telephone Company vs. the Montreal Street Railway Company. The appeal was from a decision rendered by Judge Davidson dismissing plaintiffs' action for $27,626.07, damages alleged to have been suffered on account of defendants building and operating an electric railway on the streets of Montreal. The first proceedings of the case were instituted by plaintiffs in January, 1894. It was maintained by plaintiffs that the current from defendants' wires had seriously injured many of the plaintiffs' telephone wires; that on account of the influence of defendants' wires plaintiffs had been compelled to construct costly return ground wires; that the defendants had not the proper authorization from the city council for operating its system now in vogue; that the damage to plaintiffs' wires could have been obviated by defendants using a double instead of a single trolley system; that for these and other causes plaintiffs should be awarded the sum claimed. In answer to these allegations defendants produced proof to show that the Street Railway Company had been given license to operate an electric railway on the streets of the city; that if plaintiffs had expended money on improving the telephone system defendants should not be held responsible for it; that the city council had the power to authorize an electric system to be operated on the streets of the city without first consulting plaintiffs; that said city council had in its contract with defendants specified that the electric system used by the street railway was the same as now in vogue; and that in consequence defendants were in no wise responsible if plaintiffs had suffered loss by its operation; that the streets of the city were as free for defendants to use as for plaintiffs. Sir Alexander Lacoste rendered judgment on the appeal, dismissing it with costs, upholding the judgment of Judge Davidson. The learned judge, after going exhaustively into the facts of the case, decided that the city council acted legally when it authorized electricity to be used by the Montreal Street Railway Company as a motive power; that they had power to sanction the system now used by defendants being operated in the city; and that, finally, the streets not being the private property of the Bell Telephone Company, it could not assume control of them and sue for damages; for these, and other reasons, the judgment rendered in the Superior Court was upheld and the appeal dismissed with costs.

Mining Matters.

OIL was struck last month at the Parkhill, Ont., Mineral Oil Syndicate's test well on S. Atmore's farm.

GOLD has been reported from several new locations in Simcoe county, Ontario.

ANTHRAXOLITE is reported from Gooderham, Ont., near Lindsay. The deposit is said to be extensive.

FROM Kamloops, B.C., come reports of very rich mines situated in a fine grazing country, and within a few miles of the C.P.R.

THE General Mining Association, Ltd., Sydney Mines, N.S., has ordered two Lancashire boilers from I. Matheson & Co., New Glasgow.

ASBESTOS which is said to be a particularly fine quality is said to have been discovered by W. Bannister and Jno. Rutherford, on Fish Creek, 25 miles from Calgary, N.W.T.

AS knowledge of the mid-east-Ontario mineral region increases, the gold-bearing area grows in size. It is now shown to extend north as well as east and west from Hastings county.

CLOSE to the Fire Mountain prospect near Harrison Lake, B.C., another claim has been opened up, the principal owner of which is J. Leckie, Vancouver. One assay ran $300 in gold.

FREE gold has been found, it is said, in the Black Bear. The lower workings of Le Roi show considerable free gold, and it is regarded as possible that it may develop into free milling mines.

ENGLISH experts who have been inspecting the large iron deposits in the vicinity of Conception Bay, Newfoundland—deposits more than 14 miles long—report favorably on the quality of the ore.

IT is now stated that the Deloro mispickel mines in Hastings County, Ont., are turning out $1,000 a day in gold. The company has, besides its regular staff, three gangs of prospectors hunting for fresh leads.

GOLD has been discovered at Jay's River Road, three miles from Milford, N.S. The lead is said to be over 100 feet wide, and consists of porphyry and pyrites, sprinkled with gold and galena. It assayed $24 to the ton.

GEORGE W. PIERCE and F. H. Lippett, part owners of the Colorado Ore Sampling Works, of Denver, Col., were recently in Slocan, B.C., looking for a site for ore sampling works to be established in that region.

THE first International Gold Mining Convention will convene in Denver July 7th, 1897, and continue in session during the 8th and 9th. This is the first step towards uniting the interests of those taking part in this most important industry.

ACCORDING to the Coldwater, Ont., *Planet*, Benjamin Dempsey and John Yates, of Midland, Ont., were in and around Coldwater and icinity recently, taking the heights of land and examining the ground, and have discovered oil in the neighborhood.

CHARLES R. MAY, of the Easton & Anderson Company, London, Eng., manufacturers of mining machinery, has been in the Marmora district recently superintending the erection and starting of a new ore crusher on the property of the Gold Fields Company.

DREDGING for gold is to be carried on extensively on the Saskatchewan this season. Six mining scows have been built at Walter & Humberstone's yard, Edmonton, this spring. All but one will use steam machinery. It is reported that work will start on three others shortly.

THE famous "Paris Belle" case will go to the Imperial Privy Council. This is the Nelson and Fort Sheppard Railway Co. *vs.* Jerry *et al.*, in which the railway claims under its Crown grant against the miners' claim. The property in dispute is situated in the town of Rossland, and is very valuable.

AN employee of the Canadian Gold Fields Company has discovered a very fine vein of gold-bearing quartz on the company's property in Marmora, and F. Landenberger, of Belleville, Ont., says that he has struck a rich vein 9 feet wide, of free-milling gold-bearing quartz on his property in the township of Gwinsthorpe.

SIR HENRI JOLY DE LOTBINIERE recently published a letter from the secretary of the B. P. Gold Property Co., Ltd., which offered him 20,000 fully paid-up shares in the company for the use of his name as a director. Such schemes are worked every hour of the day. How is it that Sir Henri's exposure is the only one made as yet? It is in the public interest to publish such matters. Sir Henri's reply was: "If I had the remotest idea of taking any shares in your company, the offer you make me by yours of twenty-second instant would be sufficient to prevent me."

THE announcement comes that gold has been found in paying quantities in Lavant township, Lanark county, Ont., on the farm now occupied by John Ferguson. Late last fall Barry & O'Brien, Renfrew, interested themselves in the find, and sunk a shaft to the depth of seventy-five feet. Samples were assayed and are reported to have given an excellent yield.—*Lanark Era.*

THE Ottawa Mining and Milling Company, of which the Hon. G. E. Foster and Messrs. Levi Crannell, A. W. Fraser, Geo. Hay, Hiram Robinson, John Coates, Charles Magee, E. Seybold, and J. Mather, are the leading stockholders, will, it is said, erect a customs stamp mill for gold ores on the Dick and Banning water power, about four miles from Rat Portage, Ont.

THAT the man who buys shares does not always buy a mine is well known, but it remained to be established that you might buy a mine and still have nothing, as below from an exchange: "The Orphan Boy, in the Big Bend country, considered a very valuable free milling proposition, with a large amount of ore on the dump, was sold under the hammer for $6,300 to satisfy the judgment of its manager, Mr. Haskins."

THERE is some great tunnel work being done just now on the Iron Colt, says the Rossland, B.C., *Miner.* The Iron Colt had made a contract with the Alberta company for the use of their tunnel, which is 350 feet long, not 300 as first stated, and starting at the end of this, with a depth of 160 feet, the Iron Colt tunnel will run 300 feet to connect with the shaft and pierce the ledge at a depth of 350 feet. Mr. Heacock, who ran the Alberta tunnel, has been engaged by the Iron Colt company to take charge of this work. The work is being done with a Rand giant drill—the largest drill ever brought into camp. Its cylinder is 3¾ inches in size, and with 90 pounds of compressed air it makes 300 strokes per minute, carrying 800 pounds with each stroke. It easily drills 18 inches in five minutes, a wonderful performance in the hard rock of this camp.

THE Government has determined on a vigorous administrative policy in the Yukon country. Thomas Faucett, Dominion Topographical Surveyor, has been appointed the first regular gold commissioner in that country, and with a staff of assistants, numbering seven, has started for the field. The party goes direct to Dawson City, at the junction of the Klondyke with the Yukon, and their time of duty extends over a period of two years. The duties of gold commissioner have until now been performed by Inspector Constantine, who is in charge of the North-West Mounted Police, but they have of late become so heavy that the departments, of necessity, had to be separated. To carry out the work as at present proposed it is believed the mining laws will have to be amended. William Ogilvie of the Department of the Interior will start for home when Mr. Faucett arrives at his destination, but other eastern officials will be sent out to engage in other departmental work. Among these will be a few surveyors, whom the government proposes sending to make a survey of the feasible waterways into the country.

Railway Matters.

THE trackmen on the C.P.R. have recently received an advance of ten cents per day in wages.

THE G.T.R. shops at Brantford, Ont., are working more hours per week at present than has been the case for many years.

DIVISION Engineer Chapman, of the G.T.R. at Allandale, Ont., recently examined the site of the proposed new elevator at Midland, Ont.

R. MARPOLE has been appointed general superintendent of the Pacific Division of the C. P. R., in place of H. Abbott, who has resigned.

S. SECOMBE, G.T.R. car foreman at Montreal, has been ordered to London, Ont., to assume one of the foremanships in the car shops there.

A LOCOMOTIVE exploded in the Intercolonial round-house at Richmond, N.S., May 14th, and the building was wrecked and the railway tracks torn up.

THE G.T.R. will double track its line between Montreal and Richmond, Que., at once, in preparation for the increased traffic consequent upon the rebuilding of the Victoria bridge.

IT is reported that acetylene gas is to be tried for lighting purposes in carriages on the London (Eng.) and North-Western Railway; it has already been experimented on with satisfactory results.

BIDS are asked until June 15 for the purchase of first mortgage bonds, amounting to $1,497,324, and 10,640 shares of the capital stock, amounting to $1,064,000, of the Port Arthur, Duluth and Western. Toronto General Trusts Co. are the agents.

THE work on the new buildings at the harbor terminus of the Ontario, Arnprior and Parry Sound Railway is progressing rapidly The company is building two large docks, some twelve hundred feet each in length, and a cross dock for coal.

THE office of assistant general manager of the C. P. R. has been abolished, and Thomas Tait has been appointed manager of the company's lines east of Fort William, office at Montreal, and William Whyte has been appointed manager of the lines west of Fort William, office at Winnipeg.

A BILL respecting the Canada Atlantic Railway Company has been approved, providing that the company may extend its line from the present terminus at Lacolle, St. John county, Que., to points on the northeasterly boundaries of the States of New York and Vermont, crossing the River Richelieu by a bridge at Lacolle. Five years are given far the completion of this work, and the company is authorized to issue bonds to the extent of $25,000 per mile.

IT is announced that Malcolm & Ross, railway contractors, have secured the charter of the Restigouche and Western Railway, a line projected to connect with the Baie des Chaleurs Road at Campbellton, N.B., and run to St. Leonards on the St. John River, a distance of 110 miles. At Van Buren, Me., just across the river from St. Leonards, the new line will connect with the Bangor and Aroostook Railroad.

MUCH comment is made upon the British Columbia Government's plan for bonusing the Cassiar railway. The Cassiar country is to a certain extent like the Yukon, a rich gold country of immense area, but difficult of access, and dependent upon the coast for supplies for the miners. The application for this railway has been made by Warburton Pike, the great hunter. The Government promises to lease for 50 years to the company blocks of land not to exceed 10,240 acres per mile for each mile of road built. For this the railway must pay one and one-half per cent. royalty on all precious metals taken out, $50 a year for each claim taken up, $100 a year for every transfer of a claim, 50 cents per thousand for milling timber cut, and 25 cents per cord on cordwood, and 5 cents a ton royalty on any coal mined. These railway lands during the term of the lease are open to entry by free miners who, however, must give the company a half interest in any mine they stake out.

Industrial Notes.

CALGARY, N.W.T., recently voted $3,000 to replace the Elbow bridge.

CANADA MILK CONDENSING Co., Antigonish, N.S., has been incorporated.

THE Mac Machine Co , Ltd., Trail, B.C., is building a foundry 40 x 50 feet.

A DAM and bridge were carried away by a flood at Ile Verte, Que., recently.

A NEW Methodist church to cost $12,000 is to be erected at Renfrew, Ont.

THE Matane, Que., River bridge was carried off by a freshet a short time ago.

E. CANNIFF, of Winnipeg, has perfected a machine for preventing prairie fires.

THE Whitelaw Trading Co. is establishing a central butter factory at Brandon, Man

THE capital of the Prescott, Ont., Elevator Co., Ltd., has been increased from $175,000 to $300,000.

CITY ENGINEER MURDOCK, of St. John, N.B., recommends the installation of an additional high level pumping plant at Silver Falls.

SENATOR SNOWBALL'S saw mill at Chatham, N.B., has been thoroughly overhauled and new machinery added at a cost of $10,000.

BARBER & WATSON, iron founders and manufacturers of water wheels, Meaford, Ont., have dissolved partnership. C. Barber continues the business.

JOSEPH ROGERS' new sawmill at 16 Island Lake, Montfort, Que., is nearly built. It is to have a complete modern equipment and is expected to be running in about four or five weeks. Mr. Rogers is the pioneer settler of this vast lumbering district.

GEO. VICK & SONS, Orillia, Ont., will rebuild their flour mill at once.

CLARK & UTLEY, of Salmo, B.C., are building the bridge across the Salmon River.

SAULT STE. MARIE, Ont., is agitating for a sewage system to cost at first about $40,000.

THE Wire Fence Manufacturing Co., St. John, N.B., is shipping its product to the East Indies.

M. ROBSON, Ayr, Ont., will build an elevator at once to take the place of the one recently burned.

THE stand-pipe of the Deseronto waterworks was completed last month by A. Davis, engineer, Montreal.

THE moulders in the McClary Manufacturing Co.'s stove-works are fully employed after a five weeks' lay-off.

THE bridge across the Bastican river at Price's Mills, St. Stanislas, Que., was carried away by a freshet recently.

TENDERS have been let for enlarging and improving St. James' church, South London, Ont., at a cost of about $6,000.

ROUELLE & HALLACK, late of Seattle, under the style of Robson Milling Co., will establish a sawmill near Robson, B.C.

A CONTRACT for a new public school on Albion street, to cost $14,800, has just been let to Schultz Bros. of Brantford, Ont.

BRANTFORD, ONT., is trying to secure a furniture manufacturing firm to occupy the Bain wagon works building in that city.

THE Maria Pulp and Timber Company, Maria, Quebec, on the north of Bay Chaleur, expect to begin work the 1st of June.

THE by-law granting a bonus of $6,000 to the Bowmanville Rubber Manufacturing Company was carried by a large majority, May 22nd.

WILLIS CHIPMAN, C.E., Toronto, and Col. T. H. Tracey, C.E., of Vancouver, have been asked to estimate on a sewage system for Rossland, B.C.

THE McEachren Heating Co. has decided to build a new pattern shop. It will be added to the old Cant foundry building that the firm recently purchased.

PLANS have been invited by the New Brunswick Government for a new bridge across the Big river at Bathurst, N.B., to be of steel, with stone buttresses

IT is estimated by J. A. U. Beaudry, C.E., that the cost of improving the Sherbrooke, Que., water works, if the city should take control of them, would be $80,000

LEATHER & WATSON, steel and iron merchants and agents for railway equipment, Hamilton, have removed to their handsome new offices at the corner of King and James streets.

THE pipe foundry of J. & C. Hodgson, near Montreal, is to be opened soon. The factory has been closed during the last four years, owing to the duty on their raw material being too high.

MYER & WHITE, gas and gasoline engine manufacturers, Auburn, Indiana, have written the Mayor of Hamilton, Ont., with reference to the establishment of a branch of their industry there.

THE MacGregor-Gourlay Co., Limited, Galt, Ont., is now turning out the semi-automatic bicycle hub machines, and recently shipped one to the Welland Vale Bicycle Co., St. Catharines, Ont.

IT is said that Mr. Windler, of New York, has bought lands on the Saguenay river, Que., from Terres Rompers to Caron's Falls near the mouth of Riviere aux Sables, and will build a pulp factory there.

THE Carnegie Steel Co. has closed one of the largest contracts it ever made. It is for 18,000 tons of steel to be used in the construction of the new bridge, to replace the Victoria tubular bridge at Montreal.

THE property and plant of the Lunenburg Iron Co., Ltd., were sold recently to G. N. C. Hawkins, acting for the People's Bank, for $4,000. It is expected that the company will resume business shortly.

THE John Watson Mfg. Co., Ltd., Ayr, Ont., capital $75,000, will manufacture agricultural implements, etc. The incorporators are: J. Watson, sr., J. D. Watson, W. D. Watson, A. E. Watson, E. D. Watson, Ayr, Ont.

A NEW acetylene gas machine, the invention of James G. Kerr, a young Canadian of Niagara Falls, Ont., is now claiming attention. It is claimed the invention permits of replenishing the supply of calcium carbide, from which the acetylene gas is generated, without allowing any of the gas in the machine to escape, or in any way interfering with its working. The spent carbide is also removed at the same time, the whole operation occupying less than two minutes time, and is done without soiling the hands.

THE Irondale, Bancroft and Ontario Railway bridge over Baptiste Lake was wrecked not long ago. The bridge is 1,922 feet in length, with pile approaches at either end, the centre spans being upheld by wooden piers.

WILLIAM JESSOP & SONS, the well-known steel manufacturers of Sheffield, contemplate having a permanent branch in Toronto, and will erect a new warehouse this year if a suitable building cannot be obtained ready to hand.

ALBERT E. REED, a large paper manufacturer of England, has purchased the Masterman sulphite pulp mill, on the Miramichi river, N.B. He proposes to enlarge the capacity of the mill, so as to bring its product up to 30 tons per day.

THE Minister of Public Works has decided to at once proceed with the construction of a fireproof roof for the Western Block of the Ottawa Parliament Buildings, to be built of terra cotta and iron. The work will be done by day labor.

THE St. Raymond Company, of St. Raymond, Que., is seeking incorporation, to carry on business as pulp manufacturers. The promoters are J. Macfarlane, F. W. Evarts, W. Drake, G. F. O'Halleran and E. H. Barber, and the capital stock $50,000.

CARLETON PLACE, ONT., will probably buy a hook and ladder truck with chemical engines, as at present the town has only one steam fire engine, and the underwriters have notified the council that the rating will be changed if better fire protection is not afforded.

PROFESSOR C. H. MCLEOD, superintendent of McGill College Observatory, has reported to the Department of Marine that finally the longitude of Montreal has been determined. The difference between the true latitude of Montreal and that previously stated is about eight feet.

THE George White & Sons Co., Ltd., of London, Ont., will be incorporated to carry on the machinery manufacturing business of Geo. White & Sons. Capital, $170,000. The incorporators are: G. White, H. B. White, H. J. White, W. White, F. J. White, E. A. White, London, Ont.

ENGINEER BUCK, who superintended the drawing of the plans and construction of the new arch bridge at Niagara Falls, is now in the employ of the Upper Suspension Bridge Company, preparing plans for a new bridge of similar construction. The new bridge will be over 1,200 feet long.

THE authorities of the Methodist Church at Aurora, Ont., are among the first to adopt the acetylene gas for church illumination. They have placed an order for a 50-light plant with the Niagara Falls Acetylene Gas Machine Co., and the church will soon be lighted with the new illuminant.

THE firm of Schlistig Bros., Brooklyn, N.Y., has had a representative in Toronto lately looking into the prospects of establishing a glue and button factory in Canada. They have practically decided to establish such a factory, costing $500,000, and employing between 200 and 300 hands.

G. W. YARKER, on behalf of the Duryea Motor Wagon Co., New York, has obtained permission from the Dominion Government to import free of duty, into Canada, a sample motor delivery wagon for three months, but not to be used for hire. The wagon company is looking for a manufacturing site in Canada.

THE G.T.R. foundry at Hamilton, Ont., is to be operated in future by a private company, which will make all the car wheels for the G.T.R. in Canada. Messrs. Griffin, of St. Thomas, Ont., and Drummond, of Montreal, are the chief proprietors of the new company. The iron used will be from the Radnor, Que., forges.

J. A. & W. B. HONEYMAN, owners of the Union Iron Works and the City Foundry of Portland, Ore., have decided to erect a foundry and machinery shops in Nelson, B.C. They will make iron and brass castings, manufacture boilers, mining and steamboat machinery, and do general machine manufacturing and repairing.

THE Richmond Industrial Company has abandoned the dam and factory property in accordance with the judgments of the Superior Court and the Court of Review, and dropped the appeal before the Supreme Court. A curator to the property will now be appointed by the judge, and it will be sold to satisfy the town's claim for debt and costs.

THE Toronto Industrial Club. Lt'd, proposes to build an apartment house to accommodate 600 people. Proposed capital, $300,000. In this connection it is only necessary to remind investors that well-finished houses, in excellent repair, to accommodate families of, say, five persons, can be had in Toronto within one minute's walk of the electric cars, at from $6 to $12 per month.

ADAM HOPE & Co., wholesale hardware men and dealers in iron supplies, Hamilton, Ont, have assigned. The trade liabilities are placed at $15,000 and indirect liabilities at $60,000. The Bank of Commerce and Bank of British North America are interested to the extent of $45,000 advanced on warehouse receipts.

THE engineer's plant for the sewage works of London, Ont., include a steel highway bridge across the river at the foot of King street, having a 163-foot span, with 305-foot steel approach on the east side and 153 feet on the west side. The roadway would be 16-foot with a five-foot foothpath. The bridge is necessary to carry a main sewer, and the traffic arrangements are supplementary to this.

THE International Association of Machinists, in convention at Kansas City, Mo., in May, elected the following officers: President, James O'Connell, Chicago; grand foreman and editor of the *Journal*, B. Douglas Wilson, Chicago; secretary-treasurer, George Preston, Chicago; general executive board, Harry Smith, New York; J. Holmes, Toronto, Ont.; Stewart Reed, Toledo; P. G. Conlan, Kansas City; Hugh Doran, Chicago.

WATSON & MCDANIEL, Philadelphia, for whom Garth & Co., Montreal, are agents, are getting out patterns and putting in som fine matrice tools to produce a line of steam separators, back pressure valves, and entirely new straightway and duplex valves, mainly for bottom blow-off for steam boilers, and are also introducing a new hydraulic operating valve recently patented by Mr. Riggin, who has charge of the hydraulic department of Penna R. R. shops at Altoona, Pa.

THE Master Plumbers' Association of Toronto met May 12th, W. J. Burroughs, president, in the chair. Nine new members were admitted. The principal business of the evening was the election of delegates to attend the convention, to be held in this city from July 1st to 3rd. The Palmer House was selected as headquarters for the delegates, and the meetings will be held in Pythian Hall. It is expected that every part of the Dominion will send representatives. W. J. Burroughs and A. Fiddes, on behalf of the Toronto Association, will represent the National Association, and the following the Toronto Association: Geo. McGuire, Alex. Purdy, Jas. B. Fitzsimmons, K. T. Allison, Jas. Wilson.

OUR Canadian pulp factories should take advantage of the hint conveyed in a recent report regarding the making of a new material for flooring, wainscoting, etc., and which is being exploited largely by German manufacturers of wood pulp. The pulp is dried and desiccated into a dry powder, which is put up into convenient sized packages and sold to builders and consumers generally. This powder is all ready to mix with water like ordinary cement and is spread over the surface intended to be covered. It dries quickly and adheres closely to the surface and may be tinted any color desired. It is in a certain measure fire proof, and can, it is said, be smoothed with a plane like ordinary wood.

MAUDE BENNETT, the widow of the late Dickson P. Cottingham, in her quality of sole executrix to the estate of her late husband, doing business at 1822 Notre Dame street and 19 Phillips square, has assigned at the demand of Major Freeman. The liabilities amount to $17,155. The principal creditors are: Canada Paint Company, $2,854; R. C. Jamieson & Co., $2,884; Sherwin Williams Company, $1,483; W. Warland & Co., London, Eng., $935; Meakins & Co., $715; Montreal Rolling Mills, $708; B. & S. H. Thompson & Co., $702; J. Cox & Son, $624; A. Ramsay & Son, $593; Thos. Bryan, London, Ont., $525.

IT is about thirty-three years since James Morrison started a brass foundry in Toronto. In 1893 the business had grown to such an extent that a joint stock company was formed with an authorized capital of $300,000. Of this sum two-thirds was paid. Losses by bad debts in the business and unfortunate investments made by Mr. Morrison proved too heavy a drain on the business for its continued prosperity. At a meeting of creditors an offer of 20 per cent. cash was made to unsecured creditors on unsecured liabilities of $38,000, and accepted by all present. The Jas. Morrison Brass Manufacturing Co. will continue the business as formerly.

THE fencing manufactured by the Page Wire Fence Co., of Walkerville, Ont., has evidently found favor with consumers throughout Canada, as the company's warehouse is almost depleted of stock, although new looms were added this year sufficient to increase the capacity of the factory by sixty per cent. The wires made for the Page patent fence are hard spring wires specially manufactured for this particular purpose; and in the moving of the cross wires, the running wires are coiled in such a way that while all the necessary strength is imparted to the fence, the individual wires have the elasticity needed to save it from the effects of a sudden blow.

As a preliminary to the repair to the reservoirs the Montreal water works department will do the following work: Two new 30-inch values, one 24-inch valve and one 20 inch valve, $3,500; altering valves on pipe track $6,500, connecting the 30 inch main from No 1 turbine to the two 24 inch mains in the tunnel at the wheelhouse, $1,200; connecting the 30-inch main of No. 1 engine to the 30-inch main of No 1 turbine, $1,600, connecting No 2 engine to the 30-inch main of No 1 engine, $1,700—a total of $14,500

Marine News.

A STEAMER service between Cleveland, O., and Rondeau, Ont, is proposed.

THE Thousand-Island Steamboat Co has amalgamated the Alexandria Bay Steamboat Co.

THE C.P.R. has almost completed its new steamer at Roseberry, B C., for use on Slocan Lake

WM. WALKER, Kincardine, Ont., is engineer on the steamer "Crandella," Lindsay, Ont., this season

THE dredging of the Thames from Chatham, Ont., to Lake Erie, is ordered by the Dominion Government.

A. M. PHILLIPS, acting superintendent, has been appointed superintending engineer of the Rideau and Tay Canals.

MICHAEL DELANEY'S tug "Charles Stewart Parnell" was destroyed by fire, May 20th, at the Grand Trunk wharf, Owen Sound.

THE St. John, N.B., city council is pushing the harbor improvements, and wharf building and dredging are going on vigorously.

CHIEF ENGINEER ANDERSON, of the Marine Department, has chosen a location for a lighthouse on Flower Pot Island, P E I, which will be built during the summer.

THE steamer "Nellie H.," recently launched at Chatham, N.B., was built by J. M. Ruddock, at the Miramichi Foundry's yard. She is 45 feet long; beam, 9 feet.

JAS. ROBINSON'S new boat "Irene," is now being fitted up at the Miller Chatham Foundry and Machine Works, Chatham, N.B. She is 36 ft. 3 in. long; 11 ft. 3 in. beam.

P. P. YOUNG recently launched his new steamer "Majestic," for service on Stoney Lake, Ont.; Capt. Scollard will sail the "Majestic," and Ed. Young will be mate.

THE Fort William *Journal* reports that J. Servais has placed the machinery in a new boat at Wabigoon. It is a flat-bottomed boat fifty feet long and drawing two feet of water.

THE new steamer for the Maritime Sulphate Fibre Company, being built by the Chatham Foundry and Machine Works, is approaching completion. She is length, 56 ft.; beam, 12 ft. 4 in.

A NEW steamer launched recently from Ross, Hall & Brown's wharf, Rat Portage, Ont., measures thirty-six feet in length and eight feet beam, and was built by the Degagnes for John Knight.

THE schooner "Sapphire," Capt. Wm. Cox, of E. B. Marvin & Company's fleet, one of the largest of the sixty sealing vessels that make Victoria, B.C., their headquarters, was completely destroyed by fire and explosions recently near Uclulet.

J. H. BALDERSON, Deputy Minister of Railways and Canals, has been superannuated, and will have leave of absence from first of June to first of July at his present salary. On the first of July he becomes superannuated at a salary of $690 a year.

THE double disaster which recently wrecked the steamers "Ruth" and "Gwendoline" of the Intercolonial Transportation Company, running between Jennings and Fort Steele, B.C., deprived the company of both its steamers, and leaves Fort Steele without any outlet to the south. This means a loss of $50,000 to the company.

THE "St. George" was launched recently from Hon. J B. Snowball's shipyard at Chatham, N.B. The new steamer is a side-wheeler and intended to be employed as a sea-tug in the work of towing Mr. Snowball's barges between his mill at Tracadie and the loading berths at Chatham. She is 119 feet long; 25 feet beam and 12 feet 3 inches deep.

M. & N. K. CONNOLLY, who are now at work on a big dredging contract, at Philadelphia, have secured a contract from the Government of Uruguay, for the construction of a canal sixteen miles in length. The contract price is said to be over $10,000,000. They will start work almost at once, and the probability is that some Canadian workmen will be employed by them.

S. L. Long has been appointed city engineer of Rossland, B.C.

G. H. Garden, C.E., of Montreal, has gone to assume charge of a surveying party at Crow's Nest Pass for the C.P.R.

A large pipe organ is to be presented to Zion Church, Berlin, Ont., by Mrs. C. Breithaupt, in memory of the late E. C. Breithaupt.

James Hendrie, Winnipeg, a member of the Land Titles office staff, was drowned in the Winnipeg River, near White Mouth, recently.

Douglass Gerrard, St. Thomas, Ont., has been appointed assistant engineer of the T.,H. & B. branch of the Michigan Central, at Hamilton.

R. W. Brock, M.A., acting lecturer on mining and assaying in the Kingston, Ont., School of Mines, has been appointed geologist on the Dominion Geological Survey.

Andrew Anderson, for many years the cable underground manager of the Gowrie mine, has accepted a similar position with the North Sydney, C.B., Mining and Transportation Company.

Recently the employees of the Cornwall Electric Street Railway Company, Ltd., presented the secretary, F. N. Seddall, with a valuable smoking set and an umbrella, accompanied by an address expressive of their esteem.

Granville Cunningham, general manager of the Montreal Street Railway, has returned to England to superintend the construction of the new electric railway system of Birmingham. During his further absence, Mr. Wanklyn, manager of the Toronto Street Railway, will have the oversight of the Montreal system. James Ross, vice-president of the Montreal Company, has accompanied Mr. Cunningham to England.

FIRES OF THE MONTH.

May 4th.—J. Harriman's planing mill, Niagara Falls, Ont.——May 11th.—S. Morley's flour mill, St. Ann's, Ont. Loss $8,000.——May 11th.—Brown & Bogg's machine shop, Hamilton, Ont. Pattern room destroyed; loss $1,500.——May 13th.—The Nova Scotia Lumber Co.'s mills at Sherbrooke, N.S. Insurance, $15,000; loss, $20,000.——May 14th.—J. B. Stringer's elevator, Haycroft, Ont. Loss $2,000.——May 16th.—Waterloo, Ont., Mfg. Co.'s foundry. Loss $5,000.——May 16th.—The premises of the Schlater Asbestos Co., Montreal.——May 18th.—C.P.R. station at West Selkirk, Man.——May 19th.—F. W. Galbraith's planing mill damaged $200 by incendiary fire.——May 22nd.—C. Norsworthy & Co.'s foundry, St. Thomas, Ont.; damages fully insured.—— May 24th.—W. A. Simpson's planing mill, Queen st., Toronto. Loss, $12,000; insurance, $2,000.——May 27th.—The Gartshore-Thomson Pipe Foundry. Damages amounted to several thousand dollars.

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Notice.

The undersigned on behalf of John Isaac Thornycroft, of Chiswick, County of Middlesex, Eng.; the owner of the following Canadian Patents, viz.—No. 39,547, dated July 30th, 1892; No. 39,570, dated July 30th, 1892, both for "Improvements in Steam Generators," and No. 52, 451, dated 28th May, 1896, for "Improvements in Water Tube Boilers," hereby gives notice and advises manufacturers and the public generally that the said patentee is ready and willing to grant licenses and permits to any persons desiring to undertake the manufacture of the said inventions in Canada, and also to sell, construct, and use the same, and that terms and conditions may be known by applying either to the patentee, or to

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DAY LOADS FOR CENTRAL STATIONS AND HOW TO INCREASE THEM.*

BY J. A. KAMMERER.

At no period since the inception of the electric lighting industry have central station managers and operators taken such a deep interest in all the details of their plants. As an evidence of this, there is no more encouraging sign than the constant desire by operators for the most complete information concerning, and a fuller understanding of, the apparatus they are using. This interest is not exhausted by enquiring and becoming familiar with the different points in the apparatus they are using, but is extended to the underlying principles of the relation between the cost of producing electric current, and the compensation received therefrom. Study of this relation is being logically and systematically undertaken, and is more and more made a basis upon which the earning capacity of the plant is calculated. The result of this movement is making itself felt in no small measure by those pioneers in electric lighting work who are now profiting by their experience and reaping the first benefits of the departure from old lines of conducting electric lighting business. The ruinous effects of many of these old business methods are now largely recognized by central station managers, and their energies are being directed to retrieve what has been lost in the past in this respect. They are re-arranging their plants, or are completely reconstructing the same, with more efficient apparatus. One of the first questions asked by a pioneer central station manager, when he desires to purchase a new piece of apparatus is, "What is its efficiency?" not "What is the price?" He knows that the true value of everything in connection with central station work, in fact, with the entire plant, is "efficiency" or cost of operation, and "quality" or cost of repairs. His whole work must be to make the plant more efficient, and less expensive to operate and repair, and hence more remunerative in order to pay a dividend on the invested capital. This is being brought about in part by the reconstruction and rearrangement of the central stations, and is the first and essential step, but the effort does not stop at this work.

Other means of procuring remunerative return for energy expended and capital invested must be and is being sought. Increase of rates cannot be looked for, therefore additional income at present, or at even less rates, must be obtained. Such additional revenue must be obtained from increased and prolonged use of current, to obtain which, means of having current used for other purposes than illumination must be found, and consequently use in the day-time or a "day load," as it is called, must be secured. It is claimed, and it must be admitted with some truth, that because the particular business of electric lighting companies is night work, they should not look for a day load, any more than a woolen mill or any other kindred industry should look for a night load. This at first blush looks reasonable, but were the margins on the woolen mills or other commodities as small as they are in most of our cities and towns on electric lighting, the woolen mill would either have to close up, or make its plant investment work day and night to make ends meet. Then here is where the dividing line can be clearly drawn. The one industry or industries can exist because the margin of profit on their product is sufficiently large to pay a reasonable return on the capital invested by operating their plant at its maximum output only 10 or 12 hours out of 24. On the other hand a central station operating a lighting load only is handicapped because it cannot procure a maximum load for even 2 hours out of the 24. Its maximum investment is therefore only exerting its full earning power for less than 2 hours instead of 10 or 12 hours daily.

The aim then must be to place electric lighting central station business on the same footing as any other industry, by making the plant investment work a greater number of earning hours in each twenty-four. To accomplish this there must be, in addition to its regular work, a day load for the lighting plant. The operation of a day service for electric lighting prevails only in a few of our larger cities. This is usually had, however, by a separate service, necessitating the investment in and operation of two systems, one for lighting and one for power—which is too expensive for small central stations, and still leaves the question of the maximum in-

*A paper read before the Canadian Electrical Association.

vestment and maximum earning hours unsolved, as the lighting system will still have only a very small day load, as against whatever a separate power service might earn. The difficulty must therefore be met by making as small an investment as possible in what will take care of a combined light and power load. The multi-phase alternating current system, by which motor power can be provided as well as arc and incandescent lights, meets the situation in this respect. With existing single phase alternating current lighting plants, the change can be made without any considerable expense other than in the generator, as everything is already in place for the lighting, and the only expense for motor service is a small increase from time to time on capital account, as demand is made for power.

No capital invested need lie idle waiting for business to turn up, as there can always be a return in sight on any investment before the extension is made. This holds good to a greater degree where a new plant is being installed, as the outlay is proportionately less, owing to the fact that arc and incandescent lights as well as power may be served from the same circuits and generator. In this manner the central station is in a position to cater for a day load. The cost of supplying a day load, in comparison with a night load only, is very much less, as the fuel necessary to start up the cooled boiler, and that for maintaining banked fires during the day, would be saved. The depreciation on apparatus would be slightly greater, but the interest on everything and the depreciation on lines, poles, etc., is the same as if it were only an all-night run, thus making the additional expenses for the day run much less than the night run alone. The central station operator is then in a position to give lighting service all day long, and add to his lighting business those consumers who have been heretofore objecting to using incandescent light, because of the necessity of maintaining coal oil or gas lamp lighting in dark places in stores, cellars, etc., during the day. Where there is an electric light day service such consumers cannot offer the excuse now made that risk from fire is as great with a few gas jets or coal oil lamps, as though they were to light throughout with an open flame light, and that the matter of the small additional cost of incandescent light is not their reason for not using it. As the central station can remuneratively furnish incandescent light throughout the 24 hours, this objection is removed, and a large amount of profitable business, which before could not be handled, can now be secured. In dry goods stores where delicate fabrics are being handled, and where an open flame light creates risk from fire, the objection that different delicate colors cannot be distinguished by artificial light is removed, as an arc lamp can be placed in these stores operating from the alternating current system, which gives a near approach to solar light, and makes it an object for the storekeeper to instal this light, as by it delicate colors are easily distinguishable.

By an all-day service there would be removed another hindrance to extended use of incandescent light. The objection is frequently and fairly offered that if incandescent light is only available during the hours of atmospheric darkness, or from dusk to daylight, it is necessary to have in reserve and ready for use at all times another source of artificial light in case of very dark days; and the conclusion is reached and acted upon, that as it is necessary to have a number of these lamps on hand, which must be kept ready for use at any moment, electric light being available during only a portion of the 24 hours, there is no reason why it should be used at all, although if available at all times it would be used because much preferred for so very many reasons. While the additional revenue secured from these lights may not be sufficient to pay the extra expense of running a day service, yet it must be borne in mind that it is not alone the day load the central station is getting, but also an additional night load consequent on customers being provided with light for the full 24 hours. This must be taken into consideration as making the night load more remunerative at a very small added cost.

These, briefly, are the points from a lighting standpoint that will commend themselves, and, no doubt, are familiar to most of the central station operators.

Aside from all this is the strictly speaking day load, which consists of the motor load, and which it is possible to secure with the multi-phase alternating current system. As a rule there is the butcher with his meat chopping machine, the baker with his dough-mixer, the newspaper with its printing press, the foundry with its line of shafting to drive, and the planing mill with its machinery to be kept going throughout the day, in every town, while other and larger industries will be attracted to a town in which a day power service may be obtained. These different industries all using power during the daytime, tend to create a steady load line, which is especially desirable, as it increases the number of hours in which the investment is exercising its earning power, and helping to increase and secure the maximum load line throughout the 24 hours.

WHY SOME LIGHTING PLANTS DO NOT PAY. *

BY F. C. ARMSTRONG.

Before proceeding to a discussion of the subject proper of this paper, it is necessary to fix a standard by which it may be determined whether a given plant is paying or not. A fair definition, taking everything into consideration, would seem to be that a plant which earns twelve per cent. per annum or over on the capital investment, which at present prices of apparatus and material would be required to provide an equipment of equivalent earning power, should be considered as a paying investment. In this definition we imply that 6 per cent. net per annum is a fair return for money invested in an enterprise of this nature; that 6 per cent. per annum is under present and prospective conditions a reasonable and sufficient allowance for depreciation; and that the capitalization upon which these charges are made should suffer the material and arbitrary reduction necessary to bring it down to the basis of present selling prices of electrical equipment. Regarding the first of these postulates a strongly affirmative view may be taken. Electric lighting has established a reason for being, beyond question, amongst modern industrial enterprises. Abundant artificial illumination for safety, need or convenience has become an indispensable requirement of our present multiplex civilization. The electric light supplies this necessity, it is safe to say, in spite of Welsbach burners or acetylene gas, more completely than any present, or as far as we can see, any possible competitor. The central station is a shining example of the sound economic principle of concentration of production and diffusion of output, which means commercially that under most circumstances it is cheaper

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to get your light from a central station than to instal an isolated plant. It may, therefore, fairly I think be conceded that, whatever may have been the vicissitudes of the past, the money invested in a central station to-day is entitled to take rank as a safe conservative and first-class investment from which a return of 6 per cent. per annum should be regarded with satisfaction.

The sufficiency of the allowance of 6 per cent. to cover depreciation is more open to discussion, and in it is really involved, as well, the soundness of the third assumption. In order to clear the way to a fair consideration of this matter it must be kept in mind that the depreciation of electrical apparatus in the past, and to a measurable degree in the future, is of two distinct kinds. The first is in the depreciation proper, due to the wearing out of the machinery and appliances in service ; the second, and in the early days of the electrical art vastly the most important, is the arbitrary depreciation which is due not to the wearing out of the plant, but to its becoming obsolete by reason of the introduction of newer and more efficient and satisfactory types. There can be no question but that the unparalleled rapidity of development of electrical science and the electrical industry which has crowded the progress of a century within one decade and a half, has borne heavily upon the earlier investors whose faith and courage made this marvellous progress possible. The apparatus produced in the tentative stages of electrical evolution was naturally crude and often unsuitable for the purpose for which it was sold, since the principles governing its operation were only dimly understood or guessed at, and that often incorrectly. Considered in the light of present standards, the units in use were, in view of subsequent requirements, absurdly small ; the commercial efficiency of generators, distribution lines and transformers when used was very low ; regulation, with all which it entails in plant efficiency, was practically non-existent. The steam plant on the market too was in a much less advanced stage of development than at present, and the relative suitability of varying types had as yet to be determined. Contrasting with this the present condition of the art, we find that in the best types but little room is left for improvement along present lines. The efficiency of the best dynamos of to-day is exceedingly high, 90 per cent. or better at full load being an ordinary guarantee for even the smaller sizes. Regulation in the best machines, both for incandescent and arc lighting, is practically perfect. As an example of the stability to which the highest grades of apparatus have attained by a gradual course of evolution, we may instance a widely-known machine —the ironclad armature type of alternator, as constructed by a number of the principal manufacturing companies. Experience has established its perfect adaptation to the purpose for which it is primarily intended—the supply of alternating currents for incandescent lighting. Its design renders possible the highest attainable efficiency at all loads ; the regulation by the simple device of compounding provides compensation not only for armature reaction, but also for line and transformer drop, ensuring an even potential at the lamps, and permitting the use of lamps of ten, twenty, or thirty per cent. higher efficiency than was possible with hand regulation. The ironclad construction of the armature secures perfect mechanical protection of the conductors buried in the slots, and these are made easily removable for repairs in case of damage. The high self-induction caused by burying the coils beneath the iron of the armature affords the best possible protection against burn-outs by lighting or short circuit. The single-phase system for which these machines are designed is admittedly the simplest and most economical for lighting distribution. Altogether, therefore, it is evident that this machine, which is selected simply as a familiar type, has proved itself in experience to be admirably adapted for the work which it is called on to perform.

Setting aside all unessential peculiarities in design, by which one or another machine or appliance may be recommended, as against that of a competing manufacturer, there can be no question that for both incandescent and arc lighting the best types to-day are practically perfected for the work which they are called on to do, and have therefore reached a reasonably permanent and stable form. This being the case, the arbitrary depreciation charges to which an investment in electric lighting plant was formerly subjected are no longer to be feared, and that the depreciation due to the natural wearing out of the machinery in service is covered by the allowance made for that purpose, no one will probably be inclined to dispute. In the matter of current prices, whilst improved methods of manufacturing and the keenness of competition may be expected to cause from time to time some further reductions, the bottom may fairly be said to have been touched in most lines of standard supplies and machinery.

Involved in the foregoing, at least by inference, is of course the conclusion that the wasted capital represented in the balance sheets of most companies by obsolete and discarded plant bought at the high prices of the early days should be wiped out ; if not by the summary process of reduction in capital stock, at any rate in so far as it affects a reasonable and just decision as to the profitable nature of the field offered by electric lighting under the conditions which obtain to-day.

Having thus defined the standard by which we may judge whether a lighting plant pays, we may now indicate briefly some of the causes of failure to realize the modest basis of earning power which we have set forth, and which is the very lowest which can be regarded as satisfactory. The matter is too large for proper treatment within the limits of a convention paper, even with its scope restricted by leaving entirely out of consideration the central stations of the larger cities. I shall therefore only attempt to suggest by touching very generally on some of the more evident cases and causes of failure, a set of conditions the real root and remedy for which will be apparent to the experience of the members of this Association.

The subject naturally divides itself into two sections, the one, failure by reason of mistakes in management and business methods ; the other, failure through mistakes in engineering and the actual operation of the plant itself. In the first, a sufficient cause for the non-success of the enterprise is often found in the personnel of the management. In this respect central stations are of five classes : the first, those which are in charge of a manager or superintendent who may be specially trained for the work, and who devotes his attention exclusively to it; in the second place, those whose management is in the hands of a man who divides his time between it and his other business interests ; the next is

the large class of small stations which manage themselves, with occasional interference on the part of the owner; in the fourth place, and I say it with due deference, we have the lighting stations which are run as appendages to a gas plant, by a gas manager, and which, treated with the care and indulgence which falls to the lot of a necessary evil, make precisely the return on the investment which might be expected. There are notable and happy exceptions, but I regret to say that the rule with this class of stations is as I have stated. Finally, we have that Ishmael amongst lighting stations, which its enemies say always, and its exponents say never, comes under the caption of this paper. I mean the municipal plant. In it we have quite often an ingenious combination of all possible methods of mismanagement. Speaking generally on this point, it will, I think, be admitted that there is to-day no industry representing an equivalent money investment, and possibility of public service, which is so generally managed by men who know little or nothing about it. But the special knowledge and training which comes with experience is in a new business not readily obtainable. The ideal manager will come with time; some of him is here to-day.

The electric light is a manufactured commodity offered for sale to the public; for it there exists in each community, a certain possible maximum sale; and with it to a greater degree than with most other manufactured products, the cost of production per unit is reduced as the output is increased. The question of rates is therefore an all-important one in deciding the earning power of an electric lighting plant. I will venture the assertion that in most flagrant cases of plants which positively refuse to show any margin on the right side between gross revenue and operating expense, the remedy lies in cutting down the rates to the point which will force a large increase in the business. A plant which supplies 200 lights at $10 each per annum has a revenue of $2,000 per annum, and may not pay; the same plant, if increased to 1,000 lights at $5 per annum, would probably be paying handsomely. It is evident also, that, like the telephone, central station electric lighting is a natural, and when conducted upon proper lines, a beneficial monopoly. The supply of current for lighting and power within a certain area can unquestionably be carried on more economically from one than from two or more competing stations. The benefits of such economical production may be shared alike by producer and consumer. When such is the case the security for the investment rests on the soundest possible basis, the rates being brought low enough to realize the fullest development of the business within the prescribed limits, the satisfaction of the public being ensured, and plainly no opening for profitable competition being left in dividing up a business which, even when extended to the utmost limits, and therefore carried on under the most favourable conditions, affords only a reasonable profit on the money invested.

In connection with rates and the field for business, the arc light contract properly comes up for consideration. Its value now-a-days to the average station is very doubtful. The development of the incandescent lighting, and more lately the power business, has established a reasonably secure and permanent market for the output of the central station, and to this fact more than any other are due the improved conditions now noticeable in the industry. It is unfortunately true that a large proportion of the existing investment is in many cases represented by dynamos, lamps, poles, lines, etc., which are valueless except for the purposes of the street lighting contract, but even under these circumstances it would in most cases pay the lighting company far better to devote their energy and plant capacity to a development of their proper and permanent business, adding whatever new capital may be necessary to properly equip them for the purpose, rather than continue their profitless and uncertain tenure of the municipal contract.

Also in connection with rates comes up naturally the question of a meter or contract basis. We are leaving out of view now, of course, the case of the large city plants. While on the face of it, it would seem reasonable that the current for electric lighting should be measured for sale like any other manufactured product, and not sold by bulk and by guess, there is at bottom a sound reason for the instinctive tendency to continue on the contract basis noticeable in many plants. The reason is, though, not always clearly understood that a mere measurement of the number of units taken to supply a customer for a given time is not a fair measure of the cost, and therefore of the selling price of the units supplied to him. This rests on the fact that all units do not cost alike. Those produced at 6 p.m. for example, the period of maximum load, cost far more than those supplied at 11, in the main and governing item of charge per unit from capital investment. Accordingly the meter measurement of quantity is not a measurement of value or cost, but only an approximation to them upon an erroneous basis. To meet this discrepancy it has been proposed to install two or more meters to measure current taken at heavy and light load periods of the plant, a larger discount being given for the latter. The basis of contract rates which is general throughout Ontario really represents this condition fairly well, the shop and business rates being relatively high, and the residence rates low considering the number of units actually supplied in each case. At the same time it must be recognized that in all cases with the larger, and quite frequently with the smaller plants, especially those supplying a day service, the meter method becomes imperative as being the only method whereby a check can be kept on the consumer for actual lighting supplied. In all cases where meters are used a meter rental should be charged, and a minimum monthly charge for each lamp installed provided for in the contract. Otherwise we frequently find a large part of the lamps connected to a central station, to provide for which a continuous charge on account of capital is going on, returning nothing whatever in the way of earnings for months at a time, and then coming in for the most favored customer treatment of the largest consumer.

Another point in connection with the relationship of the central station and the customer is the basis upon which wiring of consumers' premises is done. The vicious principle of free wiring has been practically frowned out of existence, but one equally mischievous has in some instances taken its place—that the wiring department should be conducted at a handsome profit. The correct principle is, of course, to give the customer for your current the fullest benefit of the present low prices for all interior wiring supplies in order that more and more lamps may be installed and the profits obtained in a legitimate and permanent form.

There are a number of additional matters which might be touched upon in considering this side of our subject, such as the effect of the competition of coal oil, gas and Welsbach burners ; the recent Governmental regulations and certain desirable extensions of the same, and so on. Not the least important of these, in view of the certain benefits to be derived, is the building up of this Association into a strong and compact organization, able on the one hand to protect the industry in which its members are engaged from the attacks of conflicting interests or of ignorant and harmful legislation, and on the other hand by a frank interchange of experience and opinion to assist in hastening the day when Progress and Profit shall be the happy watchword in all cases describing the conditions of central station operation.

It was intended, had space permitted, to discuss the subject of this paper from the other standpoint which has been mentioned—that of engineering and operation, taking up first the question of selection of apparatus which would give the ideal plant for each set of conditions, and considering in how far deviations from such an ideal installation were responsible for failure to get best results in a given case. Such a consideration of the matter, however inadequate in itself, could not fail to bring out points in discussion which, checked by the actual experience of the managers of central stations present, would become of the utmost value.

For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

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CHAPTER II.

TRAIN RESISTANCES AND THEIR COST.

ART. 6.—TRAIN RESISTANCES.

It is necessary in a study of routes, especially in instituting comparisons of the advantages of alternative ones, to understand the nature, amount, and cost of the resistances which are offered to the hauling of trains, inasmuch as they have a direct effect on the working expenses of a railway.

These resistances may be any or all of the following, depending on circumstances; but the first four always exist in operating over even a level straight track.

A.—(1) Journal friction in the car trucks.
(2) Rolling friction, on the rails, of the car and engine wheels.
(3) Incidental—stopping and starting resistances.
(4) Velocity (wind and oscillating resistances.)

B. Grade resistances.

C. Curve resistances.

(*A*) *Level Tangent Resistances.*—In the earlier years of railways, due to imperfect track, workmanship, etc., the journal and rolling friction was found by Clark to be about seven pounds per ton (2,000 lbs.); since then, however, the researches of Wellington and others have shown that on a good track, at ordinary speeds of over 10 miles per hour, these resistances are :—

Loaded Cars—4 lbs. per ton in summer.
" —6 " " winter.
Empty Cars—6 " " summer.
" —8 " " winter.

A change of 60° F. in temperature, showing an increase of 50 per cent. due to poor track, ice, snow, etc., and to an inherent increase in the co efficient. Morin's law, that friction is independent of pressure or velocity, was deduced from data of a limited range, and does not hold true for extreme cases, the empty cars showing a decidedly higher co-efficient ; but when we consider the co-efficient in its relation to velocity the matter becomes more important. At the point of starting a train, the co-efficient is found to be as high as 18 to 20 pounds per ton, for loaded cars, and even higher for empties, being composed of friction + stiction ; the latter disappears the instant that motion begins, and the co-efficient falls suddenly, to perhaps 10 or 12 pounds per ton, at one or two miles per hour, and goes on steadily decreasing as the speed increases ; but above 10 miles per hour the change is not very appreciable. Should a train get "stalled" on a grade, or be at rest at a depot, it is plain that the *maximum* load cannot be hauled on the *maximum* grade ; this matter will be taken up further on.

It will thus be seen that under ordinary cases the force necessary to propel one ton along a level, straight track at ordinary speeds, and disregarding velocity resistances, varies from 4 to 8 lbs., depending on the time of year, condition of load, track and rolling stock ; in future calculations in these papers it will be taken at 6 lbs. per ton for loaded train.

The resistance offered to movement through space by the air has been extensively experimented on. The weight of evidence until recently was in favor of the belief that the resistance varied as (velocity) ^{2}. Based on this belief, the formula deduced for total level, tangent resistance on railways, by Clark, was :—

$$\text{Lbs. per ton hauled} = R = 7 + .0052\ V^2 \quad (1)$$

(V being in miles per hour), in which the latter term represents the effect of the wind. Wellington also, as a result of the Burlington tests, made at moderate speeds, gave the following empyrical formulæ :—

Lbs. per ton (*a*) for loaded flat cars $= R = 4 + .0065\ V^2 + .57\frac{V^2}{W}$ (2)

" " (*b*) " box or psgr. cars $= R = 4 + .0075\ V^2 + .64\frac{V^2}{W}$

" " (*c*) " empty flat cars $= R = 6 + .0083\ V^2 + .57\frac{V^2}{W}$

" " (*d*) " box or psgr. cars $= R = 6 + .0106\ V^2 + .64\frac{V^2}{W}$

Where the 2nd term represents the head and side air resistances, and the 3rd term the effect of oscillations, which being chiefly in the engine, decrease, per ton, as the train gets longer, V = miles per hour W = gross weight of train in tons.

TABLE V.

POUNDS PER TON FOR TOTAL LEVEL TANGENT RESISTANCE

Speed in Miles per hour.	Clark (1) $7 + .0\ 52\ V^2$	Wellington 2(b) $4 + .0075\ V^2 + .64\frac{V^2}{W}$ (W = 450 tons.)	Wellington (3) $2 + \frac{V}{4}$	Average
10	7.52	4.89	4 5	6
20	9 08	7.56	7.0	8
30	11.68	12.03	9 5	11
40	15.32	18.27	12 0	15
50	20.00	26 30	14 5	20
60	25.72	36.12	17.0	26
70	32.48	47.71	19 5	33
80	40.28	61.08	22.0	41
90	49.12	76.27	24.5	50
100	59.00	93.20	27.0	60

Recently, however, the very high speeds obtained on various trial runs, and even scheduled trains, have thrown doubt on the idea that at high speeds, at least, the resistances could vary as the (Velocity)^2. In 1892, Mr. Wellington, after a study of Dudley's experiments on the New York Central Railway at speeds of 51 miles per hour, Sinclair's experiments on the same road at speeds of 50 to 75

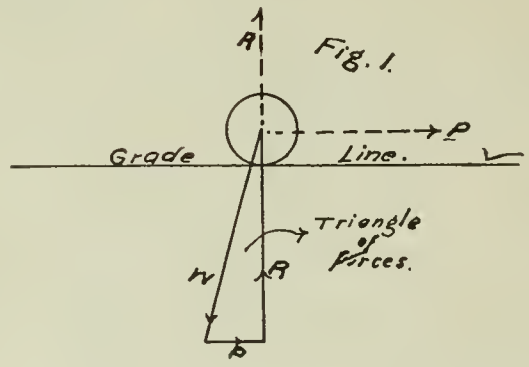
* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

miles per hour, Worsdell's experiments on the North Eastern Railway of England at speeds of 5 to 86 miles per hour, and Crosby's wind experiments, arrived at the formula: Lbs. per ton $= R = 2 + \frac{V}{4}$ .....(3) for speeds of over 40 miles per hour, but considered that at lower speeds the increased axle friction affected the results.

By which it will be seen that Clark's formula, fixed on years ago, is very close to the average, being slightly too high at low speeds. For the purposes of ordinary calculations the column of averages will be used. It is noticeable that at speeds of over 40 miles per hour, the wind resistance is a very large factor, while in freight hauling it is unimportant. And although passenger traffic is being carried on at higher speeds year by year, the addition of vestibules set out flush with the sides of the cars will very materially decrease that eddying around each car which forms a large part of the air resistance, while a pointed prow to the engine has been experimented on in France, and might be found advantageous at extreme speeds. The internal losses of a locomotive are, of course, not considered here, but the power as delivered to the rim of the driving wheels. The rolling friction of the engine wheels, being external to the engine, however, are included. The internal losses are about 10 per cent. (*i.e.*) 90 per cent. of the power developed may be applied to overcome the various train resistances.

(*B.*) Grade Resistances.

Grades are usually expressed as that per cent. which the rise or fall in a given distance is of that distance, or less frequently in feet rise or fall per mile of distance. Thus:—A grade of 1 in 100 = 1 per cent. grade = 52.8 feet per mile (in Figure 1); the forces which hold the



weight W, in equilibrium, are:—R, the reaction of the rails, and P the pull up the grade, the ratio of $\frac{P}{W}$ (or more precisely $\frac{P}{R}$*) is seen to be the same as the rate of grade, or, up say a 1 per cent grade, the force necessary to propel a ton at a *uniform velocity*, $= \frac{1}{100} \times 2{,}000$ lbs. = 20 lbs., and other grades in direct proportion; in other words, grade resistance is a definite calculatable quality, and varies with the grade only.

Velocity Head on Grades.—If a train is not moving at a uniform velocity, the energy stored up in it is not constant; but varies with the speed of the train. This energy may be expressed in so many feet which the body would need to fall to acquire the velocity corresponding to a given amount of energy or velocity head $= h = \frac{v^2}{2g}$ where $v =$ velocity in feet per second, or, if we change to V miles per hour, we get $h = \frac{1}{2 \times 32} \times V^2 \times (1.5)^2 = .033V^2$ .....(4) In addition to this there is the energy stored up in the revolving wheels, which will, for ordinary cases, increase the total energy of the train in motion about 6 per cent., or change the formula to $h = .035V^2$ .....(5).

The values for h for various velocities are as follows:

TABLE VI.

V (miles per hr.)	5	10	15	20	25	30	35	40	45	50	60
h (feet)	0.8	3.5	7.8	14.0	21.9	31.5	42.9	56.0	70.9	87.5	126.0

In considering velocity head, as it affects grades, we may treat it (*a*) as it affects stopping and starting, (*b*) as it permits of fluctuating speeds and a conservation of energy.

(*a*) The amount of force necessary to expend in starting a train, over and above what is needed to keep it moving at a uniform velocity, under the same conditions, will depend on the distance through which it acts. If, for instance, it is desired to start a train from rest and acquire a velocity of 30 miles per hour in 1,500 feet, the virtual additional grade will be $\frac{31.5}{15.5} = 2.1$ per cent. grade, and the additional grade resistance will be $2.1 \times 20 = 42$ lbs. per ton *to be added* to any train resistances that would exist if the train were moving at a uniform velocity. In the same way in stopping a train the brakes absorb the stored up energy more or less rapidly depending on the length in which the stop is made (*e.g.*) a stop in 250 feet from a speed of 20 miles per hour $= \frac{14}{2.5} = 5.6$ per cent. grade to which the brake friction is equivalent $= 112$ lbs. per ton.

(*b*) Although it is usually considered that the grades of a road are certain definite inclines, this is only nominally so; actually, the "virtual" rate of grade against which the engine has to contend depends on what fluctuation of speed can be allowed between the foot and the top of the grade, and the length of the grade. The method of calculating "virtual" grades is as follows: Take an assumed speed, of say, 30 miles per hour at the foot of the grade, and a safe minimum speed to prevent stalling, of say 10 miles per hour at the head of the grade, then the difference of their velocity heads $= 31.5 - 3.5 = 28$ feet. Now this 28 feet, or whatever it may be (it may usually be limited to 25 or 30 feet), is to be deducted from the total actual grade to give the total virtual grade. It will be seen that while velocity head is a large item on short grades, it is insignificant on long ones. Thus great economy of construction can be effected often by the introduction of short, steep grades (*e.g.*) a 1 per cent. grade two miles long—actual lift $= 52.8 \times 2 = 105.6$ feet, virtual lift $= (105.6 - 28) = 77.6$ feet (30 miles per hour speed reduced to 10 miles per hour at summit), and the virtual grade $= \frac{77.6}{10560} = .73$ per cent.

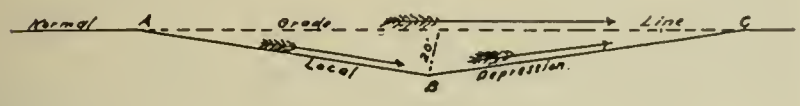
In this way on any railway profile above the actual grades should be plotted the virtual grades for different fluctuations of speed. A study of these will often enable changes in grade to be introduced, from economical motives, using short pieces of grade above the nominal maximum or dropping temporarily, in a short sag or depression, to save embankments. But the introduction of short steep grades should not be carried beyond about a 20 foot "sag" below normal; for supposing (see Fig. 2) that a train approaches A at a speed of 15 miles per hour, $= 7.8$ feet velocity head, and with uniform engine power still on, passes to B and then C, in the normal grade line, as the train passes A the tension on each draw bar will momentarily increase and the train will begin to accelerate its speed until B is reached, when the velocity will correspond to a velocity head of $7.8 \times 20 = 27.8$ feet, or will be about 28 miles per hour, from B to C; the speed will decrease and the train will arrive at C with a speed of 15 miles per hour; or, in other words, the limit of "sag" is the limit which we assign to safe freight speeds (see Chapter III. for vertical curves), and may be placed at about 20 feet, defining the point up to which local depressions, in a grade, are of no importance, and may be

* The error in taking $\frac{P}{W}$ instead of $\frac{P}{R}$ is infinitesimal, being only about $\frac{1}{100}$ lb. out of 100 lbs. on a 5 per cent. grade.

passed over with steam on, and no brakes set, or the same brakes if descending, of course, practically, no excessive dip of very high rates of grade could be used, except temporarily during construction, for sake of appearance, and because the proper use of vertical curves would eliminate them.

It is interesting to note that although the total power exerted in passing from *A* to *C* (Fig. 2) is the same as though the train had passed along the more direct grade line, the average rate of speed is increased, and the *time* of transit from *A* to *C* is *less* on the depressed grade

Fig. 2



than on the direct one. But note that a rise *above* the normal grade line is not permissible, as it would probably stall a slowly moving freight train.

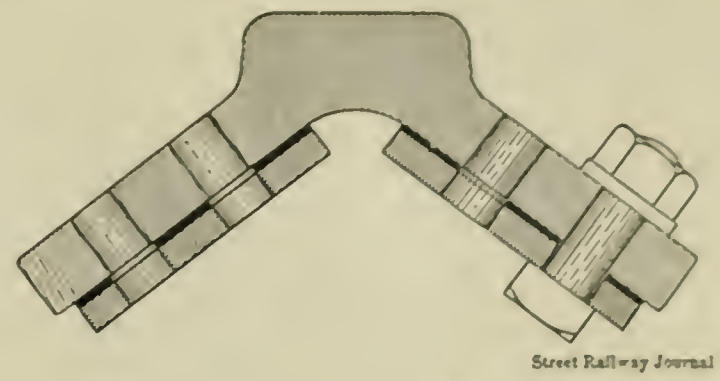
In connection with the fluctuation of speed, also, is the question of modification of grades at stopping places, where these grades are anywhere approaching the maximum, while level tangent resistance, at ordinary speeds o say 20 miles per hour, is about 8 lbs. per ton. It is as h gh as 18 to 20 lbs. per ton at zero + .. miles per hour (*i.e.*) at the instant of starting, so that any depot grade should be less than the maximum by, say, (20 – 8) = 12 lbs. per ton = $\frac{6}{10}$ grade. Also for the sake of getting up speed quickly, it should, if possible, be still further reduced, so that depot grounds are usually selected as nearly on leve ground as possible. These restrictions do not apply rigidly to light passenger or local freight trains, not loaded to the full capacity of the engine, but prevent heavily loaded freight trains from stopping at stations on grades approaching the maximum.

Another danger of yards on grades is that the wind may blow cars out on to the main line from the sidings Yards are sometimes, however, laid out with about a $\frac{6}{10}$ per cent. grade, where much sorting is done, and the cars are sorted by gravity on to different tracks.

(*To be continued.*)

THIRD RAIL TRANSMISSION.

The New York, New Haven and Hartford Railway directorate has made another advance in the application of electricity in the operation of its road, in the electrical equipment of its line running from Berlin to Hartford, Conn. This important departure differs in its electrical equipment from the line at Nantasket in that the trolley system of contact is not used. That adopted is the third rail system, the conductor or third rail being laid along the centre of the track between the running rails. The rail is rolled in 30-feet lengths, and weighs 93 lbs. to the yard. The section chosen is one which it is believed will be to a large extent self-protecting as against rain, snow and ice, as the tendency is to shed water to each side, leaving a fairly dry place immediately below the rail. This rail is mounted upon wooden block insulators impregnated with a preservative and insulating compound. These blocks are fastened to the ties by 2 inch × 2½ inch dowels, and three blocks to each 30 feet rails are ordinarily employed. The blocks are of such a length that the top of the third rail is held 1 in. above the top of the service rails, and the lowest points of the third rail are 1⅝ in. above the ties. It is necessary to have the shoe on the car carried high enough to clear the special work of the track, and the third rail low enough to avoid reaching any of the metal parts of the truck on the electric and other trains passing over the line. Careful inspection of all cars must be provided to prevent accidental short circuits due to contact of truck mechanism with the third rail.



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The third rails are mechanically and electrically connected together at their ends by heavy wrought iron fish-plates, 12 ins. × 4½ ins. × ¾ in., between which and the rails are placed ⅛ in. sheet copper bond plates of the same area. These four plates, two of copper and two of iron, are firmly bolted to the rail by sixteen ⅝ in. bolts with lock nuts and the entire double bond has a current carrying capacity equivalent to 1,800,000 c.m., which is in excess of the capacity of the rail itself.

At switches and crossings the third rail is omitted, the circuit being continued underground by stranded bare copper cables of 500,000 circular mils and in some cases 850,000 circular mils. These cables are first drawn into creosoted wooden conduits filled with an insulating material. They are then laid in creosoted wooden troughs in turn filled with the same compound and then boxed over and buried. The broken ends of the third rail are fitted with wooden inclines or approach blocks to allow the shoe to rise upon the rail without danger of catching and breaking.

The shoe is a 12 inch by 5 inch cast-iron plate and is suspended from a wooden insulated support, fastened to the truck by links joined in such a way as to give the shoe considerable flexibility. The engineering advantages of the third rail construction are obvious. The rail can be easily and quickly laid, and so insulated from the ground that the leakage is little or nothing. This has been absolutely proven. The third rail provides a conducting capacity for the current equivalent to a very large copper cable, so that on many light traffic lines copper feeder capacity will not be required. There is little sparking between the shoe and the rail, and no appreciable wear from friction. Altogether, the advantages of the third rail construction are such that there is no doubt that, in one form or another, it will become the standard method of conveying heavy currents in railroad service.

The entire plant is very fully described in the June number of the *Street Railway Journal* by N. H. Heft, electrical engineer of the New York, New Haven & Hartford Railway.

For THE CANADIAN ENGINEER.

PAINTING METAL BRIDGES.

BY WILLIAM B. MACKENZIE, MEM. CAN. SOC. C.E., MEM. AM. SOC. C.E., ASSISTANT ENGINEER INTERCOLONIAL RAILWAY, MONCTON, CANADA.

In the early part of 1895 I began to investigate the subject of painting metal bridges. After reading what literature I could obtain, I determined to make a few experiments for myself, the results of which are here presented. I do not feel at liberty to give manufacturers' names in a communication of this kind, particularly as my tests are so few; but I have no objection to giving, in a less public

way, such facts as I have, to persons interested in the subject.

Twenty-four new wrought-iron plates, one foot square and three-eighths of an inch thick each, were painted two coats of different kinds of paint, under precisely similar conditions, the boiled linseed oil being the same in all, excepting those samples obtained ready-mixed from the manufacturers. These plates were provided with hooks on the back, and hung on the lower chord eye-bars of a steel railroad bridge 1,900 feet long, across a strait or arm of the sea, in latitude 45° 56′ N., longitude 60° 59′ W. They stood vertically at a height of nine feet above the water surface, and were exposed to the sun and salt air at all times, and also to salt spray in rough weather. They faced the prevailing wind from the north-east.

This strait, or arm of the sea, is situated about 35 miles from the Atlantic Ocean, lies north east and south-west, and forms a narrow passage five miles long and 1,900 feet wide, between two large inland basins. The strait is bounded by high land on both sides, the bridge crossing it in an east and west direction. The wind usually comes from the north-east, and a light breeze causes spray to be dashed against the floor. In storms, the spray is thrown over the floor and across the bridge. The rise of tide in the open sea, 35 miles distant, is five feet, but here the rise is only six inches.

Metal corrodes here very rapidly. The bridge itself was erected in 1890. One coat of iron oxide paint was applied in the shop and another coat given after erection. In 1892, it was considerably rusted, and two coats of iron oxide paint were put on the lower chords and floor system; but without proper inspection or scraping. In 1894, scales one-eighth of an inch thick were removed from the end stiffeners of the floor-beams on the north side. Pieces of this scale were trimmed to exact dimensions and the cubic contents calculated. On being weighed, the scale was found to weigh slightly more than one-half that of new steel.

A chemical analysis of iron-rust scale from the outside of the Conway Tubular Bridge, in England, is as follows:

Sesquioxide of iron	92.9	per cent.
Protoxide of iron	6.177	"
Carbonate of iron	0.617	"
Carbonate of lime	0.295	"
Silica	0.121	"
Ammonia	trace.	
	100.000	"

In August, 1895, our bridge was thoroughly scraped and painted with two coats of iron oxide paint, the analysis of which is as follows:

Color	Indian red.	
Fineness	80.00	
Body	85.00	
Strength	70.00	
Iron oxide	48.16	per cent.
Insoluble matter	51.84	"

Adulterated slightly with clay.

It is now in good condition; but will require constant attention to remedy defects in the painted surface as they appear.

It will be seen by the record of the experimental plates (see table) that the asphalt paints, the carbon paints, the coal-tar coatings, and some of the oxide of iron paints are already out of the race, and that neither the lead nor the graphite paints are holding out quite as well as might have been expected.

RECORD OF TWENTY-FOUR PAINTED PLATES.

EXPOSED ON A STEEL RAILROAD BRIDGE OVER AN ARM OF THE SEA, LAT. 45° 56′ N., LONG. 60° 59′ W.

Mark on Plate.	Kind of Paint.	How Mixed.	No. of Coats	When Painted.	When exposed on Bridge.	Length of time Exposed.	State when examined by W. B. McK. on Nov. 30th, 1896.
I	Oxide of iron	Boiled linseed oil	2	March, 1895	April 24, '95	1 year & 7 ms.	In good condition.
II	Red lead	Raw linseed oil	2	do	do	do	Discolored and slightly rusted.
III	Graphite paint	Boiled linseed oil (?)	2	do	do	do	Small patches of rust all over.
IV	Oxide of iron	Boiled linseed oil	2	do	do	do	Rusted all over.
V	Anti-corrosion paint	⅓ raw oil, ⅓ boiled linseed ⅓ turps	2	do	do	do	In good condition.
VI	Black anti-rust paint	Mixed by the manufacturer	2	do	do	do	Very much rusted.
VII	White lead	Half raw and half boiled linseed oil	2	do	do	do	Half the plate rusted and discolored.
VIII	Tar and asphalt coating applied hot		1	do	do	do	Considerably rusted.
IX	Red lead 1 lb. and lampblack 1 oz.	Raw linseed oil (no drier)	2	do	do	do	In fair condition.
X	Oxide of iron	Mixed by the manufacturer	2	do	do	do	Very much rusted.
XI	This painted plate was supplied by a painter for test. The composition of the paint is unknown to me				do	do	Considerably rusted.
XII	Black bridge paint	Mixed by the manufacturer	2		do	do	Very much rusted.
XIII	This painted plate was supplied by a painter for test. The composition of the paint is unknown to me				do	do	In good condition,
XIV	Asphalt paint	Mixed by the manufacturer	2		do	do	Rusted all over.
XV	Carbon paint	Mixed by the manufacturer	2		Oct. 31, 1895	1 year & 1 mth	Rusted in large patches.
XVI	Oxide of iron	Mixed by the manufacturer	2	July 17 1895	do	do	Fairly good condition; a few rust spots.
XVII	Oxide of iron	Mixed by the manufacturer	2	do	do	do	Covered with rust; paint all gone.
XVIII	Graphite paint	Mixed by the manufacturer	2	do	do	do	Fairly good.
XIX	Coal tar coating; plate heated and dipped in hot tar		1	do	do	do	Rust spots all over.
XX	Oxide of iron	Mixed by the manufacturer	2	do	do	do	Fairly good; a few rust spots.
XXI	2 lbs. 7ozs. yellow ochre and 1 oz lampblack	Raw linseed oil and Japan	2	do	do	do	Good; a few rust spots on back.
XXVIII	Paint for ironwork (secret process), said to be furnace slag, linseed oil and gum	Mixed by the manufacturer	2	March, 1896	April 4, 1896	8 months	Very good.
XXIX	Oxide of iron	Mixed by the manufacturer	2	April 1, 1896	April 9, 1896	do	Small rust spots scattered over.

REFERENCES:

III. The manufacturers say that the pigment is mixed in pure kettle-boiled linseed oil, and direct that in dry weather it be thinned with raw linseed oil, and in damp weather with boiled linseed oil.

XII. The manufacturers say that the pigment is mixed in linseed oil and turpentine and that it also contains asphaltum and Kauri gum.

XIV. The manufacturers say that this paint contains no coal tar, and direct that it be thinned with 62 per cent. benzine.

XVI. The manufacturers say that the mixture of this paint is a secret process and that it contains no oil. It sets too quickly and is difficult to apply for this reason.

XX. The manufacturers say that the pigment is mixed in pure clarified linseed oil.

A chemical analysis of the water beneath the bridge was arrived at as follows:

The average density of ocean water is 1.026, and the composition is as follows:

Water	96.5	per cent.
Salts	3 5	"

The composition of the salts is as follows: —

Chloride of sodium	77.758
Chloride of magnesium	10.878
Sulphate of magnesium	4 737
Sulphate of lime	3 600
Sulphate of potash	2 465
Bromide of magnesium	0.217
Carbonate of lime	0 345
Total salts	100.000

The density of the water under the bridge was deter-

mined roughly by weighing a certain volume and comparing it with the weight of a like volume of fresh water. This gave a density of 1.00813, which would make the composition as follows :—

Water	98 215 per cent
Salts	1.785 "
	100.000 per cent.

The composition of the salts would be the same as that given above for ocean water.

The highest summer temperature of the air in 1895 was 82° F., and the lowest temperature in winter of 1895-6 was—2° F. The highest summer temperature of the air in 1896 was 72° F., and the lowest temperature in winter of 1896-7 was—7°. The summer temperature of the sea-water under the bridge is 60° F. to 63° F., and the winter temperature 30° F. to 35° F. Total precipitation in 1895 was probably about 70 inches. Total precipitation in 1896 was 69.86 inches. Snow lies on the ground, more or less, in depths from three inches to three feet, between the middle of December and the middle of April. The greatest velocity of the wind during north-east autumn and winter storms is about 60 miles per hour.

CORROSION.

Corrosion is most active in autumn and winter, because there is then more moisture deposited upon the metal, and the water contains a larger proportion of oxygen and carbonic acid.

At 32° F. water will absorb	4.9%	of its own bulk of	oxygen.		
At 50°F.	"	3.8%	"	"	"
At 68°F.	"	3.1%	"	"	"

Snow water contains more oxygen than rain or river water and will rust metal quicker. Cold water dissolves more carbon dioxide than warmer water. At 32° F. water will dissolve 1.8 volumes of carbon dioxide, and at 60° F. only one-half as much. Pure rain-water contains 2½ volumes of air in 100 volumes of water. If water is freed from oxygen by boiling, iron will not rust in it, nor will it rust in perfectly dry air. Rust consists of iron, oxygen and water and it requires a simultaneous action of oxygen and water to produce it. Damp oxygen and damp carbon dioxide in combination produce rust quickly. Neither will do so when dry either together or separately, and only to a very slight extent when damp, separately. It requires the combination of both, damp, to rust quickly.

Steel, when unprotected and exposed to the weather and sea-water, corrodes at the rate of $\frac{1}{82}$ of an inch per year	or 1 inch in 82 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{190}$ of an inch per year..	or 1 inch in 190 years.
Steel, unprotected and exposed to the weather and fresh water, corrodes at the rate of $\frac{1}{170}$ of an inch per year	or 1 inch in 170 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{430}$ of an inch per year..... ...	or 1 inch in 430 years.
Steel, unprotected and submerged in sea-water, corrodes at the rate of $\frac{1}{130}$ of an inch per year,	or 1 inch in 130 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{310}$ of an inch per year.....	or 1 inch in 310 years.
Steel, unprotected and submerged in fresh water, corrodes at the rate of $\frac{1}{600}$ of an inch per year..	or 1 inch in 600 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{700}$ of an inch per year.....	or 1 inch in 700 years.

Wrought-iron in an overhead bridge, subjected to coal-smoke from locomotives, corroded in 25 years from 39 5 per cent. or 1.8 per cent. per year to 100 per cent., or 4 per cent. per year, some of the members being entirely eaten away.

Unstrained members corrode more quickly than strained members. Shaded parts will corrode more slowly than parts exposed directly to the sun's rays.

Real iron-rust does not promote further rusting because of any chemical influence on the iron, but being a spongy mass, it retains in its pores 24 per cent. of water deposited as rain or dew. It does not, therefore, prevent, but rather encourages rusting, and in this way has a physically injurious effect upon iron. Corrosion accelerates with time, the second year's being 50 per cent. greater than the first.

LINSEED OIL.

In paint, oil is king ; any finely ground pigment, inert toward the metal and oil, will last until the oil decays and wastes away, and against this decay and waste there is no remedy. The raw oil is obtained by both cold and hot pressure from linseed, or the seed of the flax plant, *Linum usitatissimum*. When cold-drawn, the color of the oil is golden-yellow, and when hot-pressed, brown-yellow. The specific gravity is :

At 50° F. = 0.9385
" 53½° F. = 0.9364
" 59° F. = 0.9350
" 68° F. = 0.932[illegible]
" 77° F = 0.9300
" 266° F. = Boiling-point
" — 16½° F., the oil congeals to a solid yellow mass.

It is sold under different forms : Raw, refined, boiled and artist's oil. The seed should be ripe, and from two to six months old. The quality of the oil is affected by the quality of the seed, which is in turn ruled by the soil and climate in which it is grown. Boiled oil is heated to a temperature of from 266° to 600° F., and agitated mechanically for five or six hours. Water evaporates, and the scum and froth is removed from the surface with ladles; this scum is afterwards used in making putty. Equal quantities of litharge and red lead are added by slow degrees as dryers, to the extent of three per cent. of the oil, a small proportion of umber being also thrown in. The heat is continued for two or three hours, when the fire is suddenly withdrawn and the oil left covered over for ten hours longer. It is now known as "boiled oil," and is stored in settling-tanks for a few weeks, during which time the uncombined driers settle to the bottom as "foots." The heating process darkens the color and causes the oil to dry quickly, producing a hard firm surface. Pure, unadulterated linseed oil is not a common article. Driers are not infrequently added through the bunghole without boiling. Cotton-seed oil, Niger oil, hemp-seed oil, poppy seed oil, colza oil, rape-seed oil, Lucca oil, resin oil, turpentine oil, benzine, fish oil, animal oil and water are often mixed with it, all or any of which shortens the life of the paint. There are about 17 vegetable drying oils which may be used in paint, and over 30 vegetable non-drying oils, which may be used as adulterants. The greater number of these oils are cheaper than linseed oil. In addition, there are the fish and animal oils, so that the rarity of pure linseed oil is not to be wondered at.

The purity of linseed oil may be roughly tested by shaking it well ; if iridescent bubbles appear on the surface, it is adulterated with benzine or mineral oil ; if sulphuric acid is present, the paint when shaken and then allowed to stand will thicken into a brown paste. Other rough tests are : Brush it upon brown paper, and expose to the sun's rays ; the water, benzine, etc., will

evaporate and leave the oil. Dip a sheet of well-sized paper into the oil, and hang it up to dry; when dry the whole of the sheet should show a well-varnished coating; if only the bottom of the paper is varnished, the oil is insufficiently boiled. Brush the oil on a smooth wood surface; if it turns white, "blooms" in drying, it is adulterated with resin.

Oil, when spread out thinly, dries by absorbing oxygen from the air; the water and vapor passing out create multitudes of very minute holes in the oil cover, where water may enter; these holes are partly filled up by the second coat of paint. While the oil is absorbing oxygen, it adds 13 to 14 per cent. to its weight.

PIGMENTS.

After reading what the different manufacturers say about the price, covering capacity, and durability of their own particular paints, and the folly of using anything else, a person is inclined to believe fully in David's hasty assertion that "all men are liars."

The following comparative statement of the cost of painting a 100-foot span steel bridge, with a number of kinds of good paint, is taken from a statement published by C. E. Fowler, C.E., in the *Engineering News* of Feb. 6th, 1896. The cost of painting spans from 20 feet to 300 feet was accurately determined, and it will be seen that, after all, there is very little difference in the first cost between good qualities of the usual kinds of paint used for general railroad work; there being only $9.25 difference between oxide of iron and red lead for a span of 100 feet.

Cost of painting a 100-foot railway bridge (clean new iron) with different kinds of pigments and linseed oil:

Oxide of iron—14 gals. 1st coat, at 50c; 10 gals. 2nd coat, at 50c.
Labor, $68.00 = $80.00

Red lead—10 gals. 1st coat, at $1.25; 7 gals. 2nd coat, at $1.25.
Labor, $68.00 = $89.25

White Lead—14 gals. 1st coat, at 85c.; 10 gals. 2nd coat, at 85c.
Labor, $68.00 = $88.40

Graphite—14 gals. 1st coat, at 70c.; 10 gals. 2nd coat, at 70c.
Labor, $68.00 = $84.80

Asphalt—23 gals. 1st coat, at 40c.; 14 gals. 2nd coat, at 40c.
Labor, $68.00 = $82.80

Carbonizing coating—7 gals. 1st coat, $1.50; 5 gals. 2nd coat, $1 50.
Labor, $68.00 = $86.00

SCRAPING.

The labor of scraping the metal and applying the paint is from four to eight times the cost of the pigment and oil; so that there can be no economy in using cheap paint. To remove scale, loose rust, oil, dirt and cinders, use benzine, chisels and hammers, wire brushes and scrapers, as may be necessary. Unless the metal is perfectly clean and dry, no paint can be successful. Scraping should not proceed far ahead of the painting. Should salt spray touch the scraped metal, it should be scraped again before painting.

KIND OF PAINT AND ITS APPLICATION.

It is absolutely necessary that the first coat should contain a large quantity of pigment, and should dry quickly with a dense, firm surface, to receive the second coat in from 48 to 72 hours. If not dry and firm, the paint will blister, because of the separation of the first coat from the metal. To secure this, a pigment of high specific gravity must be used in boiled linseed oil, with a considerable quantity of turpentine, and we cannot do better than use a heavy, finely ground oxide of iron pigment, inert toward both metal and oil, and which has already been tested for durability, such as No. 1 of my experimental plates. Iron oxides often contain acids, lime, sulphur, clay, etc., so that there is much room for choice. Red-lead has been largely used for first-coat work, because it dries quickly, with a hard surface; but if the air, from local causes, contains obnoxious gases, such as sulphuretted hydrogen gas, produced by the passage of trains, the red-lead will be quickly destroyed. J. Newman, author of "Corrosion and Fouling," says by letter of 21st January, 1897: "Probably the *worst* paint you can use for either iron or steel is ordinary lead and oil paint." Oil alone should not be used for priming in the shop; it collects dirt and cinders; besides, the pure oil dries, but never hardens. As it contains no pigment, it is quite porous and pervious to water; the surface will consequently expand and present a shrivelled appearance and blisters will eventually appear.

For second-coat work, an elastic but firm surface is required to follow the expansion and contraction of the metal and resist the mechanical impact of strong dust or cinder-laden winds and rain, spray, hail and snow. In this coat more boiled oil, a less weighty pigment, and a less quantity of turpentine is required, so that it will dry more slowly and for a longer time resist the sun's influence, which is ever tending to harden and crack the surface and allow the entrance of water to the metal. A pigment, then, of low specific gravity must be used. Crude graphite ore powder has a specific gravity of about 0.7, and as graphite cannot be affected by chemical influences, it would seem to offer a suitable material for second-coat work. I have tested it for a period of one-and-a-half years, and so far it has done fairly well. Objections have been urged against it as follows:

1st. It is expensive to grind to a high degree of fineness, because of its oily and flaky character.

2nd. Because of its lightness, no great body of it can be got into the oil.

3rd. It settles out of the oil.

Some of these objections may be more imaginary than real.

A prominent manufacturer says that the composition of the best graphite now mined, ground and used for paint, is as follows:

ANALYSIS OF THE CRUDE ORE.

Moisture	0.15 per cent.
Graphite	33.48 "
Silica	37.54 "
Oxide of iron	14.25 "
Pyrites of iron	1.27 "
Oxide of alumina	12.35 "
Lime	0.54 "
Magnesia	0.48 "
	100.00

On referring to the statement of cost, it is seen that for a 100-foot span bridge, the cost of graphite is $4.80 greater than iron oxide.

There exists in Canada, in large quantities, a cheap natural product, the specific gravity of which, compared with No 1 iron oxide powder, is as 0.31 to 1. This material, after an inexpensive treatment, can be mixed with the iron ore powder to reduce the weight and increase the bulk, and on adding oil, a paint will be produced affording an elastic silicious surface which will resist cracking, peeling and blistering for a much longer time than the iron oxide alone.

On a clean, dry surface, paint applied at a temperature of 70° F., will last longest. Painting should not be done in damp, wet or freezing weather, and on summer mornings time must be given for the dew to evaporate before work begins, as oil paint will not adhere to wet metal. Painting should never be done by contract, but by day work, under a competent foreman. In painting it is best to begin at the top and work down. Buy paint in

powder form when possible; next best in paste form. Light colors quickly become covered with a layer of dust, which absorbs as much heat as dark surfaces. The greater the number of pigments mixed together, the shorter the life of the paint.

LIFE OF METAL BRIDGES.

Heretofore, owing to increases in train loads, flimsy construction and neglect, the average life of iron bridges has not been over 25 years, and it is now generally believed among well-informed engineers that the average existence of such properly designed metal bridges as have lately been constructed throughout the country will not greatly exceed fifty years. Where corrosion is particularly active, as at the bridge of which I have spoken, the life of the structure must be much shorter, probably not over 35 years.

An English oxide of iron paint much used in this country contains 48 per cent. of iron oxide and 52 per cent. of insoluble material, and some American oxide of iron paints contain as little as 33 per cent. of iron oxide and 60 per cent. of silica. We have in Canada unlimited quantities of iron ore, which requires no preparation except grinding. Why should we then continue to import that with which nature has so liberally endowed us, and why should we continue to use unsuitable paints on locomotives, stationary engines, cars, roofs, bridges, freight and store-houses, when good iron oxide paints are cheaper and more lasting?

The company which will produce iron oxide paint from Canadian ore, as good as the best, push its sale, and show the people its advantages for works of this kind, will benefit both themselves and those to whom they sell. Hundreds of iron ore deposits exist in Canada, some affording 72.4 per cent. metallic iron, and several extensive graphite deposits, some of which produce 50 per cent. of pure black lead, while the natural product of low specific gravity for mixing with the iron ore powder can be supplied pure in any desired quantity.

For part of the information contained in the foregoing article, I am indebted to Prof. J. Spennrath's prize essay on "Protective Coverings for Iron," 1896; J. Newman's "Corrosion and Fouling," 1896, and to several articles in engineering periodicals by such high authorities as W. P. Wood, E. Gerber, W. G. Berg, A. H. Sabin, Samuel Wallis, J. H. Stanwood, and J. E. Greiner.

ACCUMULATORS—THEIR APPLICATION TO CENTRAL STATION LIHGTING AND POWER.*

BY W. A. JOHNSON.

To those who have given attention to the use of accumulators and have posted themselves sufficiently to have even a fair idea of their adaptability, it seems incomprehensible why the central station owners in Canada have so long delayed availing themselves of their advantages.

Considerable misconception seems to exist in reference to the cost of installing a storage battery. Like all good things having value accumulators are not given away, and the station manager who is waiting for them to get cheaper is letting one-third of the earning power of his station go to waste. Local conditions, of course, determine the capacity and consequent cost of battery, but in general terms the cost may be stated to be in most cases less than the cost of generating plant. When it is desirable to increase the capacity of a station, it means besides new dynamos, increase in engines, boilers and all steam appliances, and usually alterations in the building, and while the output of the station is increased the general efficiency remains about the same, and often times the running expenses of a moderate sized station is greater per h.p. output, owing to the increase in the working staff. On the contrary, to increase the capacity of a station with accumulators, requires, as a rule, no alteration or increase of existing steam plant, no new dynamos, and usually, owing to the small space required, plenty of room can be found in the station for the storage battery.

When such a change can be made, what are the results? The available output of plant has been largely increased; no increase in working staff is required; the operating expenses are no higher than before; the all round efficiency of the station is fully 30 per cent. more, and consequently the profits are enlarged by nearly the same proportion; the plant can thereafter give uninterrupted service 24 hours per day every day in the year, as the battery is always available when a temporary shut down of the machinery is necessary. The regulation of the voltage to the lamps is kept constant—more perfect than can be possible when no batteries are used, as the battery is a regulator to the whole system. When motors are operated this is a big advantage. No gas company would for a minute consider the operation of their plant without a storage tank; just think of the large increase in retorts and men to keep up a constant gas supply without a storage tank. Most waterworks systems require a reservoir, and yet electrical people, who are supposed to keep abreast of the times, try to get along without a storage tank to fall back upon for hours of maximum, minimum or average demand.

The central station manager will answer that he does not know the cost of maintenance, and is waiting for the other fellow to prove the case. The other fellow has proved it. In Germantown, Pa., there has been a battery having a capacity of 120 h.p. hours in use for over three years, or long enough to give a fair idea of the cost of renewals. The management of the large stations in Boston, Brooklyn, and New York, however, did not await the results in Germantown, but put in large batteries from one to two years ago, and these have since been doubled, and in one case recently enlarged for the fourth time. But interested parties can go back of the returns from the United States for further endorsation of the practicability of accumulators. In Germany, France and England they have been largely used for years past. Out of a recently published list of 30 cities in Germany, only ten are without accumulator plants. The populations of these cities range from 4,000 to 85,000. This shows that there is hardly a town or city electric plant but can use accumulators to advantage.

I mention the following among American companies who have put in large batteries, and the capacity installed as rated in h. p. hours:—

Company.	H. P. Hour Capacity
Hartford Electric Co.	3,000
Boston Edison Co., four batteries, a total of	7,400
New York Edison Co.	3,200
Brooklyn Edison Co.	1,600
Germantown Electric Light Co.	300
Electric Railway, Light & Power Co., Anaconda, Montana	500
Woonsocket Electric Machine & Power Co.	400
Eastern, Pa., Edison Co.	200

These last three plants are used both for railway and lighting work.

As good an illustration as I can give of the appli-

* A paper read before the Canadian Electrical Association.

cation of the storage battery to railroad work is to refer to the equipment of the Union Traction Company of Philadelphia, who use a battery of 400 h.p. hours for keeping up the pressure at the end of a feeder at a point about 11 miles from the power house, the new extension continuing several miles beyond. In this case the battery took the place of a new power house, or what amounted to the same thing, an increase at the old power house with enlarged feed wires. It was found that the cost of copper feed wire to operate from the main power house alone would have cost four times the total cost of a battery. Previous to the installation of the battery the pressure at the end of the feeder formerly in use frequently varied as much as 50 per cent.; the battery, however, gave practically a steady pressure at all times. Railroad men need not be told how much better for their motors and controllers the maintenance of a standard working pressure is than one which falls so low as to require an increase in the current passed through the apparatus of from 50 to 100 per cent. In the above case the load varied from one hundred to seven hundred amperes, and with the feeder of a capacity at a constant load for four hundred amperes, the demand upon the power house was at all times equivalent and independent of the changeable load on the batteries. Under such an arrangement the power house generator always operates at full load and highest efficiency, and the battery acts as a cushion to the engine when the line circuit breaker opens from any cause.

Some of the electric street railroads in Canada serve a district up to seven miles from the power house as originally laid out, and in all cases extension will be called for to reach suburban points at a greater distance and to connect through as radical lines to still more distant points. In such work the accumulator plant at the end of a feeder is destined to be an important factor in the near future, and the little trouble in operating a sub-station for this work is very satisfying to the purchaser, as the battery is automatic in charge and discharge, the only attention required being the usual occasional testing of the E.M.F. of the individual elements and the keeping of the electrolyte to the standard specified gravity (1,200).

The sub-station apparatus and connections are very simple, being only the main switch, ammeter, circuit breaker, voltmeter and recording voltmeter. The flow of the current to the line being always proportionate to the demand, one central station can therefore take care of any number of accumulator sub-stations, and the area which can profitably be covered with continuous current either for railroads, lighting or power greatly increased. The claim has been made and experience seems to prove it true, that it costs practically nothing for the energy stored in accumulators in the average lighting, power or railroad station, whether operating on a twelve or twenty-four hour basis, as if judgment is used in proportioning the size of battery to generating plant, the battery is always being charged during light load and discharged during hours of heavy load, and owing to the all-round higher efficiency, the amount of coal burned will be about the same and the current given off from the batteries will represent net profit.

While the above is a simple way of putting it, the following gives in figures the actual conditions obtained in a plant now working: Total time of operating steam plant, 9 hours; total steam plant required, dynamos working at an efficiency of 90 per cent., 93 h.p.; total steam plant required if battery is not used, 165 h.p.; saving in steam plant, 72 h.p.; total dynamo capacity required when using battery, 62,500 watts; total dynamo capacity required, without battery, 111,250 watts; saving in dynamos, 48,750 watts. In this case the battery was in service a total of 18¼ hours and during 15 hours the battery served the entire plant.

In making provision for a storage battery the room provided should, if possible, have a cement or tile floor, and should be well ventilated. Owing to the compact form of the elements, sufficient room can usually be given when arranged in tiers, one above the other. The space required for a battery capable of giving 400 h.p. for one hour per element is 14½ by 20½ inches, and as 248 cells would be used on a 500 volt system, only about 630 square feet would be necessary, this being for a battery of fairly large capacity; in fact, being equivalent to that installed by the Union Traction Company in the beforementioned instance. A suitable battery having been purchased, it requires as careful attention as is given to any other class of electrical or steam apparatus, and no more, and yet this attention is very simple; but it must be given as required, otherwise the results would be similar to that caused by neglect of a dynamo or steam boiler. There has been no instance where a properly constructed battery that has received fair treatment has failed to give good results. Attention should be paid to the proper strength and nature of the acid, the specific gravity of the acid being tested at regular periods. The individual testing of each cell by a low reading volt-meter is the keynote to successful battery operation. While in general the reading of the voltmeter connected with all the elements will give sufficient information, yet the occasional individual testing of each element prevents any single cell from being allowed to work at a disadvantage. The chloride type of negative plate has been found to be most satisfactory, and is largely in use for central stations. The positive plates generally used with chloride negatives are of the Tudor type, and are capable of giving a very high discharge, their capacity being at nominal rating from three to five ampere hours per pound of element. Such a battery is not liable to buckle or sulphate. There are numerous small water powers that have not been considered as applicable to electric lighting, owing to the small h.p. available, but if 20 h.p. can be obtained for 24 hours per day, and if a battery is used in connection therewith, 120 h.p. is available for four hours, or sufficient for the requirements of a fair-sized town. I know of one instance, in a town of from eight to ten thousand inhabitants, where a water power of 50 h.p. is available, and not used at present. This power, if stored in batteries, would give 200 h.p. for six hours, or sufficient to supply all the street, commercial and residential lighting which is now operated by steam.

At the annual meeting of the Fredericton, N.B., Gas Light Company, a dividend of 4 per cent, on the year's operations was declared, and the old board of directors, composed of Hon. F. P. Thompson, president; Hon. A. F. Randolph, W. T. Whitehead, James Dever and John A. Edwards, were re-elected.

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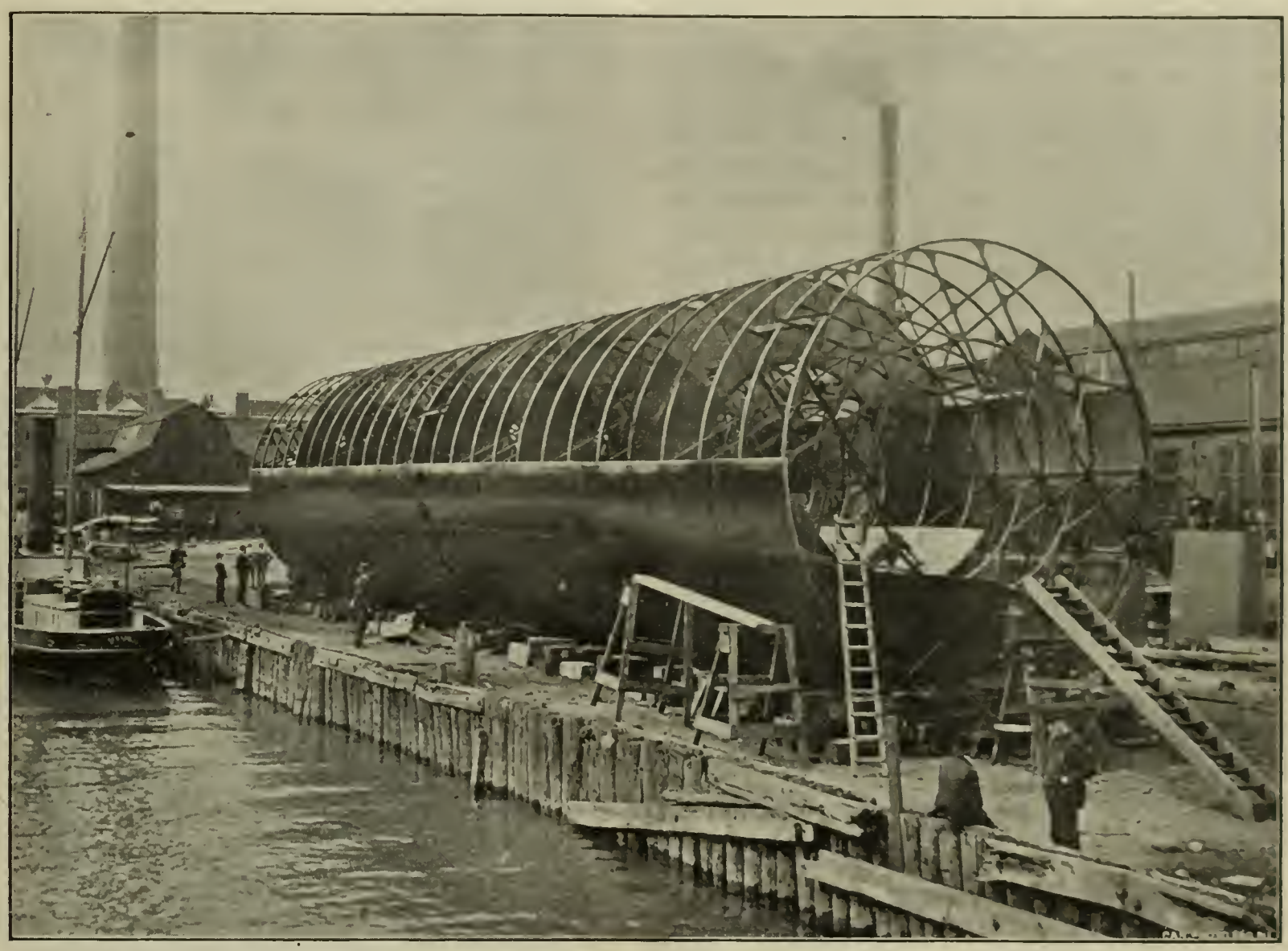
THE PUBLISHERS.

NOVELTIES IN NAVIGATION.

During the present year, a number of experiments have been made in methods of propelling vessels, some of them novel and some not. Two of these are roller boats, one of which is the invention of a Canadian, F. A. Knapp, a lawyer, of Prescott, Ont. The principle of the roller boat is not by any means new; but there are important differences in the two under consideration from others that have gone before and proved failures. That invented by Bazin, in France, has been tried, and instead of making 30 knots an hour, as it was to do, it only made six or seven. In the first type tried in French waters the engines were not powerful enough; then new engines were put in of three times the power, but the increased weight and force submerged the rollers so that instead of making 40 turns a minute, they only made 10, and they threw up such quantities of water behind that each acted like a brake. Mr. Knapp's boat, which is now being completed at Polson's shipyard in Toronto, is quite different to Bazin's. As shown incomplete in the accompanying engraving, it is a cylinder, looking like a huge steam boiler. It is 110 feet long and 22 feet diameter, the cylinder having an inside diameter of about 12 feet. The engine and platform or cabin for passengers will be placed inside this cylinder, the engine running on a track and turning the cylinder just as a squirrel might turn the cylinder in its cage. The engine being started climbs up its track and turns the drum by its own weight, the drum moving over the water by means of paddles projecting from its outer shell about a foot. The steering gear consists of a steel blade on the lee-board principle, projecting down into the water from each end and lifted or lowered by chains. The smoke will escape by pipes from either end, the inner cylinder being of course open at the ends. Mr. Knapp believes his new boat will make a speed of a mile a minute, and so it may in rolling before a gale, but going against a gale will be quite a different matter. It seems ungracious to have to discourage a thing before its trial, but it is to be feared that Mr. Knapp has not made any mathematical calculations of the enormous force of a gale acting on the broadside of so large a drum elevated so largely out of the water, and he has evidently not considered that though his engines are to be 150 horse-power, their effective power will be limited to a proportion of their weight plus that of the framework, etc., in which they are set. There are other difficulties with regard to stowage of cargo in this outer drum which are likely to crop up on trial. Undoubtedly such a boat should make a good rate of speed in smooth water and with no adverse winds.

Another Canadian inventor, Mr. Charbonneau, is building a boat near Montreal which promises more effective work. The working model of this craft consists of two cylinders somewhat of a torpedo shape, each 8 feet long, 18 inches in diameter placed parallel, and 4 feet apart from centre to centre. Around these cylinders are spiral fins of 1½ turns to the length, one set with a right turn and one with a left. These cylinders are the support of a frame and platform on which a four h.-p. gas engine is being placed, the cylinders being geared to the driving shaft by a bicycle chain. The craft is very steady in the water, and when operated by hand-power only has made a better speed than was expected. Its test with the engine, however, is yet to be made.

Herr Vass, a German, is now building a steamer to be propelled by 10 screws, the novel feature of which is that the screws will be placed at the bow and sides, as well as under and at the stern of the vessel. When we state that Herr Vass expects to cross the Atlantic in 16 hours without regard to weather, it will be seen that he is a sanguine man. Although these inventions may prove failures, partially or wholly, they will all have their value as contributing to our stock of knowledge and experience in solving the problems of fast navigation.



ROLLER BOAT.

FOUND WANTING.

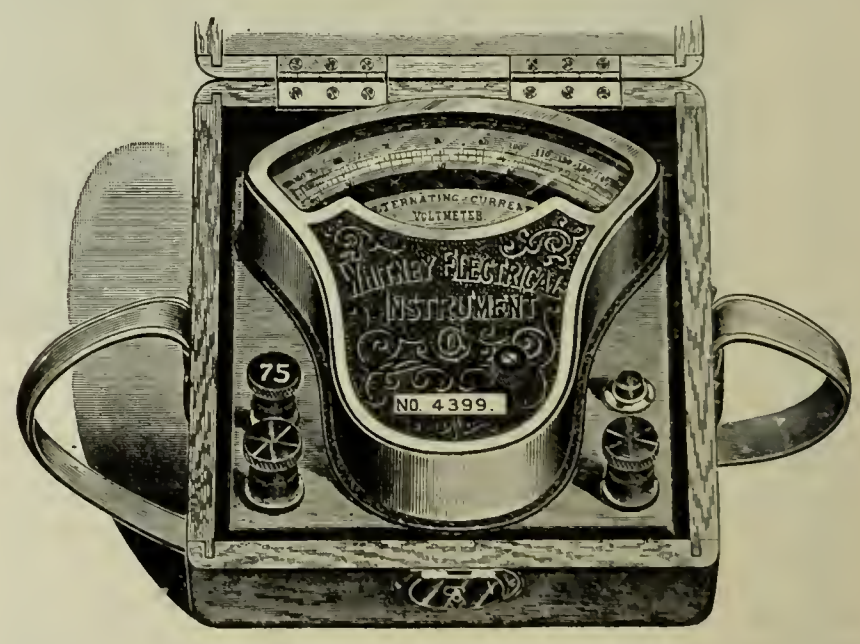
It is of course understood that many of the so-called mines, whose shares are being hawked about, have no existence save in the imagination of the alleged proprietors. That such enterprises should fail is only to be expected, and when it does occur it is a subject of congratulation to everyone interested in the development of our mineral wealth. It is far otherwise, however, when failure comes to a mining enterprise which has been conducted on thoroughly sound business principles, with the most exact scientific information, and the latest and most improved appliances. We refer with regret to the closing down of the Craig mine, Bannockburn, Hastings county, Ont., which took place on the 15th of June, the date of the expiry of the option under which it was held by the Gold Hills Exploration and Development Co. The assays, upon whose showing the working of the mine was determined, gave results indicating the value of about $35 per ton in gold. However, the ore crushed at the Kingston School of Mines, where the test was made, did not represent the average quality of the ore in the mine. The company began work January 1st, and employed about 40 men, day and night, until the 15th of June, when the operations ceased. A Tremaine two-stamp steam stamp, manufactured by the Gates Iron Works, Chicago, the first set up in Canada, was installed, with a 15 horse-power boiler and a Northey pump. Two shafts were sunk, one of 100 feet and one of 35 feet. The vein was also stripped at intervals over the whole property, and samples amounting to several tons taken from each opening. Half way down the main shaft a chute very rich in free gold, but which was very small, was struck. In all about 100 tons of ore were crushed, and the gold recovered is understood to have amounted to between $2 and $3 per ton. Horace Maybee, of the Kingston School of Mines, was in charge of the stamp mills and assaying; Gardner McKenzie, who has had a very long and successful experience in the gold mines of Nova Scotia, was superintendent, and W. Hamilton Merritt visited the mines frequently during the operations, and directed the work of development, so that there can be no question but that the property has had every opportunity to prove itself a valuable mine, and has failed to do so. The Hastings mining boom has received a serious check.

THE AUTOCAR INDUSTRY UP-TO-DATE.

"Save me from my friends!" the motocycle manufacturer may well exclaim—presuming that those persons claim to be his friends who are so constantly and strenuously puffing the industry and its wonderful development. A few days ago the daily papers announced with a great flourish of trumpets, that on July 16th next ensuing, the Cab Company of Paris, France, would put 500 autocars on the streets, replacing the antiquated animal-power. One of the officials of the company was quoted as saying that within a year 4,000 of such autocars would be running in Paris. A close scrutiny of the matter in quarters not accessible to the general public, reveals that the 4,000 is a myth, the 500 is also a myth, and the plain truth is that the Compagnie des Petites Voitures is "experimenting" with a view to the introduction of autocabs—if a satisfactory system can be found! "The type of vehicle has not been settled upon," but "negotiations" are in progress for the acquirement of a new accumulator "which is expected to give much better results than any now existing." The old, old story! The *Autocar*, the English organ of the movement, states in answer to "A Puzzled Investor," that the total number of autocars delivered from British factories up to date is "probably five-and-twenty, all told!" Some of the factories have been running about a year, others from six to nine months. "There are six companies," the *Autocar* says, "actually delivering commercial vehicles built in this country, viz., Messrs. Stirling, The New Beeston Cycle Co., the Coventry Motor Co., the Thornycroft Steam Wagon Co., and the Daimler Motor Co., and three others which will now commence deliveries in a week or two, these being the Great Horseless Carriage Co., the Arnold Motor Carriage Co., and the Yeovil Motor Carriage Co. Several more are also pushing forward manufacturing preparations." The amount of capital involved in these various enterprises is not stated, but it represents many millions of dollars, and the number of workmen runs into the thousands. Yet the net result to date is 25 autocars! No more striking proof could be given of the absolute accuracy of the article published in the May number of THE CANADIAN ENGINEER, which we suggest might be re-read in view of the facts stated in the above extracts.

A NEW LINE OF AMMETERS AND VOLTMETERS.

Appreciating the demand for a reliable, but low-priced line of testing voltmeters and ammeters for both direct and alternating current, the Whitney Electrical Instrument Co., of Penacook, N.H., have brought out a modified form of their well known Hoyt type. While it is not by any means their intention to discontinue the manufacture of the latter instruments, it has been found that although by far the most accurate method of taking measurements, instruments operated on the dynamometer principle are not as convenient for rapid testing as are the indicating type, hence the new instruments are in this form, and are constructed with especial reference to making them convenient when used as portable instruments. They are mounted upon handsomely finished mahogany bases and covered with neat dust-proof cases of aluminum, while a strong, well-made, hardwood case with lock and key accompanies each instrument. This case is designed so that the instrument can be used without removing from the case, although it can be readily removed when it is desired to use the instrument for laboratory work. Both the voltmeters and ammeters will read correctly on alternating current of any frequency, as well as on direct current circuits, and there is no appreciable heating error. The



ammeters are made in a variety of ranges from one ampere up to one thousand, and the voltmeters up to ten thousand volts both in single and in double scale. These instruments are tested to stand 2,000 volts between the terminals and cap, thus eliminating all danger in the case of grounds on the line Although the instruments are very compact, occupying a space only 6 x 6 inches, they have a scale length of nearly five inches, thus giving very open deflections.

MR. DOWDALL has been in town for several days taking subscriptions for THE CANADIAN ENGINEER, a monthly journal devoted to the metal trade's interests. We are pleased to know that the subscription list has been largely extended by the names of a goodly number of Orillia citizens, which was to be expected of a progressive community. THE ENGINEER certainly is an up-to-date publication and fills the bill with ability, and is thoroughly wide awake to the interests involved.—*Orillia, Ont., Packet.*

Photo by G. W. Whitaker, Niagara Falls, N.Y.

CANADIAN ELECTRICAL ASSOCIATION.

CANADIAN ELECTRICAL ASSOCIATION.

SEVENTH ANNUAL CONVENTION.

The seventh annual convention of the Canadian Electrical Association was held at the Dufferin cafe, Niagara Falls, Ont., on the 2nd, 3rd and 4th June, John Yule, president, in the chair.

Among those present were the following : K. J. Dunstan, Frederic Nichols, J. J. Wright, C. H. Mortimer, Geo. A. Wilkie, E. K. M. Wedd, Irving H. Smith, A. A. Christie, A. B. Smith, J. A. Kammerer, W. A. Johnson, A. M. Wickens, W. J. Clarke, E. D. McCormick, W. H. Bourne, Albert Esling, T. F. Dryden, James Milne, F. H. Leonard, jr., J. W. Campbell, Jos. Wright, E. B. Biggar, John C. Gardner, Ross McKenzie, Toronto, Ont.; John Yule, Guelph, Ont.; W. H. Browne, John Carroll, Wm. Thompson, J. A. Baylis, Montreal, Que.; C. B. Hunt, C. E. A. Carr, Capt. Williams, London, Ont.; F. Pepler, Barrie, Ont.; Stephen Noxon, G. E. Gayfer, Ingersoll, Ont.; Henry Comstock, Brockville, Ont.; George Shand, William Williams, Sarnia, Ont.; John Murphy, Ottawa, Ont.; B. F. Reesor, Lindsay, Ont.; H. O. Fisk, Peterborough, Ont.; E. E. Cary, Geo. A. Powell, St. Catharines, Ont.; James Lamont, Chatham, Ont.; Geo. Phemister, Wilfred Phillips, G. E. Foster, Niagara Falls, Ont.; E. T. Freeman, Halifax, N.S.; V. B. Coleman, Port Hope, Ont.; John Farley, St. Thomas, Ont.; F. A. Bowman, New Glasgow, N.S.; J. W. Purcell, Walkerville, Ont.; W. H. Bullard, Seaforth, Ont.; C. H. Philbrook, H. E. Adams, Buffalo, N.Y.; W. J. Johnston, Wm. McCullough, New York, N.Y.; Geo. Black, W. F. McLean, F. W. Martin, Gordon J. Henderson, B. J. Throop, Thomas Wadland, Q. C. Baker, Hamilton, Ont.; Thomas Duncan, Fort Wayne, Ind.; C. J. Page, Welland, Ont.; J. M. Brown, Carleton Place, Ont.; Chas. E. Taylor, Sault Ste. Marie, Ont.

The president, having welcomed the members, delivered his annual address, in which he spoke of the appropriateness of having the convention at a place like Niagara Falls, which afforded so many object lessons in electrical enterprises. In the course of his address he spoke of the question of municipal control of electric plants, as a subject of the deepest moment. The movement was gathering strength in spite of repulses, and some means would have to be devised to prevent a large part of the capital invested in the electric lighting business from being wiped out. "We hear," said he, "of Glasgow, Manchester and Birmingham, where the civic ambition largely prevails amongst men of capital, leisure and ability, who give their time and talents to promote the common good. The late Governor-General of Canada, the Earl of Derby, is now serving as mayor of a large English city ; while municipal affairs in Canada are managed in odd hours snatched from business, by men who cannot afford to give the time and attention necessary to the successful management of an intricate and hazardous mercantile concern like the supply of electricity. They also do not know or forget that municipal control was not introduced in England in the vicious way it is carried out in this land, by using the taxable resources of the ratepayers to ruin what was at one time, by the same people, lauded as creditable enterprise on the part of their fellow-citizens. It is not my purpose to enter into an elaborate argument why municipal control is not a success in Canada. The agitation is in the air, and how best to save our property from complete confiscation is the question of primary importance. We do not dispute the right of municipalities to control and operate all their franchises, if honestly and fairly entered into. I hope our Legislature will realize it to be their duty to provide for the compulsory purchase and transfer of properties where the local authorities decide to assume control of the lighting service, and prevent money invested by our citizens in necessary and laudable enterprises from being wantonly wasted. It is a hopeful sign that a few of our leading newspapers are now recognizing that the practice in some European countries of government control of monopolies is the true remedy for any evils that may exist. The Toronto Globe, in dealing with the telephone question, admits this principle in pointing out the mistake that would be made, and the injury to the public which would follow, should a second telephone company be permitted to enter into business in Toronto. Quite recently the same paper quoted approvingly from a paper on 'Monopolies and the People,' where the author tersely sets forth the evils of the popular attitude towards competition projects :—'Let a proposition to build a competing railroad line or a competing electric light plant be submitted to popular approval, and, under the impression that they are benefiting themselves, hard-working men will cheerfully assume heavy burdens of taxation to aid the new enterprise. So blind and unreasoning indeed is this popular abiding faith in the merits of competition, that it has been responsible for some of the greatest wastes of wealth in unproductive enterprises that have ever been known.' In Great Britain the Government forbids by legislative enactments, local authorities entering into competition with private companies, but makes it a necessary condition in their taking control of municipal franchises that all plant engaged in the business in their bounds shall be expropriated by the corporation and paid for, the value being arrived at either by mutual agreement or by arbitration. One would think from the discussions here that every municipal franchise in sight in Great Britain is operated by municipalities, but such is very far from being the case. I have not been able to procure all statistics, but will give you an example. In England, Scotland, Ireland and Wales, in the year 1895, there were 1,318 gas undertakings operated by companies, and only 165 managed by municipalities. This, in view of the fact that said muncipalities could at any time expropriate these undertakings and operate them on their own account, does not denote the marvellous success our friends would have us believe, the power to expropriate having been in existence for nearly 30 years." The president then went on to speak of the Electric Lighting Act of Great Britain, which provides for the method in which lighting companies are to be started. Companies can be organized, and on proving their good faith and ability to carry on business, notice is given to the corporation, which has then a stated time within which to take up the business on municipal account. On their failing to do so, what is called a provisional order is then issued by the Board of Trade (in England a department of the Government) to the company, permitting them to operate within their district. This provisional order is about equal to our Act of Incorporation, and gives a monopoly of the business under proper control.. Municipalities are not required to pay any price demanded by the company for lighting service. The company is compelled on a requisition from the local authorities to erect and supply street lights ; the distances apart and other necessary conditions are prescribed in the General Act. Failing an agreement as to the value of the service, arbitration is resorted to for that purpose, the Board of Trade

appointing the arbitrators. In fact, arbitration is the key to the whole situation. Every precaution is taken and provision made and no wilful destruction of property is allowed. In the State of Massachusetts all gas and electric light companies are supervised by a board of control, which has now existed for 13 years. When complaints are made, or applications for reduction in price etc., the board hears evidence and gives judgment, which is usually based on common sense and equity. Every lighting company in the State is required annually to make a return, giving full particulars as to capital, income, expenses, dividends paid, etc. In 1896 there were returns from 63 companies; 33 of these paid no dividends, 6 less than 5 per cent., and 25 paid 5 per cent. and over. If this is the condition of electric lighting investments in a wealthy and populous manufacturing State like Massachusetts, he thought statistics would show Canadian companies to be worse off." He advocated an Ontario law, based partly on the British and partly on the Massachusetts laws. In closing his address the president made a feeling reference to the untimely death of their respected late second vice-president, E. Carl Breithaupt, and said, "I am sure I express the opinion of all who had the pleasure of knowing him, that he was a young man of great promise in his adopted profession, and a genial and trusty friend. His death is a decided loss to our association."

On motion of C. B. Hunt, seconded by J. J. Wright, the following were named a committee to consider and report on the recommendations contained in the president's address: Wm. Williams, S. Noxon, B. F. Reesor, J. J. Wright, J. Lamont, H. Comstock, and the mover.

The secretary-treasurer, C. H. Mortimer, then read his annual report, which showed that there had been added during the year 42 active members and two associate members, while nine active members and five associate members had resigned, and 33 active members and 14 associates had been struck off the roll for non-payment of fees. Two members, E. Carl Breithaupt and A. W. Congdon, were removed by death—a loss deeply deplored. The membership roll now comprises 154 active members and 19 associate members, a total of 173. The finances were reported in a good condition. The total receipts were $940.36, an increase of $448.03 over the previous year, while the disbursements were $352.47, an increase of $165.86 over the previous year, leaving a net gain of $282.17. The cash in hand and in bank on 31st May, 1897, was $415.82. The report was adopted.

J. J. Wright, on behalf of the Committee on Legislation, reported that during the past year there was no legislation that affected the interests of the members generally. He also reported that nothing had been done by the committee to interview the Government on the question of meters. They found that the officials of the Government were disposed to meet them in every reasonable way, and there was no urgent necessity under the circumstances to have an interview with the Government. The coming year, however, bids fair to be an important one for these committees.

The report of the Committee on Statistics was not presented, owing to the death of the chairman, E. Carl Breithaupt, who at the time of his death had a considerable amount of unassimilated material in the way of reports, which have not yet been obtained from his executors.

The president named B. F. Reesor, C. B. Hunt and A. B. Smith as a committee to nominate the standing committees.

Mr. Hunt called attention to the Government's new order-in-Council regarding the inspection of meters. By this order the charge for inspection is per lamp instead of per ampere. To those having a 106-volt or a 110-volt service the rate is very much increased. Take, for instance, a 10 ampere meter that we used to pay 75 cents for, the rating is now $1.25; on a 15 ampere meter it is increased from $1.25 to $1.75; on a 25 ampere meter it is increased from $1.75 to $2.25; on a 50 ampere meter it is increased from $2.75 to $3.50; on a 100 ampere meter it is increased from $3.50 to $5.50, and on a 150 ampere meter it is increased from $4.25 to $7.50. If you happen to have three wire meters it will be pretty nearly double that again. It was decided to bring the matter up the next day.

A paper on "Water-Driven Plants," an abstract of which will be found elsewhere, was then read by John Murphy, of Montreal.

The President said the most satisfactory regulation he found was a quick-acting engine on the same shaft with the water wheel.

H. O. Fisk—Mr. President, we regulate about the same way as you do, although we have one water power generator with an automatic regulator, which works very well; it may lose 10 or 15 volts, perhaps, with a very sudden change of load; it never exceeds that. In our incandescent lighting we regulate it by hand, and just increase the power as the load comes on, and take it off accordingly. It works very well.

B. F. Reesor—I have had no experience with regard to driving electric plant with a water wheel—we drive ours with an engine—but I have had considerable experience in water wheels, and I can quite understand where a water wheel is taxed to almost its utmost capacity it would vary very much. The same thing holds good with an engine or water wheel, but much more so with a water wheel; it will pull it down very much in putting on a considerable load. A good plan is to have any amount of power to spare.

Mr. Fisk—In regard to governors for street railway work: I suppose that is about the hardest kind of work we have to deal with. We found down in Peterboro' that it was impossible to get a wheel that would stand governing for any length of time; the pinions and everything wear right out with the constant rocking backwards and forwards. We simply had to abandon it, and I believe for that reason that the apparatus that provides a constant load for a generator would perhaps be the best in the end. We had a couple of wheels revolving on balls, and the balls actually cut right into the iron, so that the thing came right down and ground away there, and would not work. We had no end of trouble till we took our governor off, and I have since thought that perhaps the best way is to keep a constant load on the machine if it is possible. I believe there is an apparatus working up here at Niagara Falls power-house now that keeps a constant load on the generator all the time.

S. Noxon said he had experience of water power at Walkerton, in driving two or three mills. He came to the conclusion that it was impossible to regulate a water wheel running at a slow speed, under a comparatively low head. The feed of the water being so sluggish in its action, it was impossible to get any close regulation by any governor. The trouble was to get the wheel to respond quickly. It can be done under a high head, because the wheel runs altogether with the impact of the water, and as soon as the water is shut off a little the wheel responds.

A. M. Wickens, Toronto, was then called on to read his paper, entitled the "Steam End of an Electric Plant," which, with the discussion on it, will appear in next issue.

When the discussion on this paper closed the convention adjourned for a trip to Buffalo in the evening, where an inspection was made of the electrical developments there.

On assembling for the second day, the president read telegrams from O. Higman, of Ottawa, then at Vancouver, and from L. B. Macfarlane, Montreal, regretting their absence from the meeting.

On behalf of the committee to nominate the Standing Committees, Mr. Reesor reported the following nominations, which were accepted:—

Committee on Statistics—A. B. Smith, A. M. Wickens, and O. Higman.

Committee on Meter Inspection—J. J. Wright, C. Berkeley Powell, and James Milne.

Committee on Legislation—John Yule, B. F. Reesor, J. J. Wright, John Farley, W. H. Comstock, C. B. Hunt, S. J. Parker and F. Pepler.

W. H. Comstock, chairman of the committee to consider the recommendations in the president's address, reported in favor of action by the Committee on Legislation, who should be empowered to raise money for the purpose. On motion of Mr. Armstrong, seconded by Mr. Reesor, the report was adopted.

J. A. Kammerer then read his paper on "Day Loads for Central Stations and How to Increase Them." The paper appears elsewhere.

Mr. Wright said he remembered, when a boy, seeing a conjuror who poured three different kinds of wine out of one bottle. He thought it very wonderful at that time, but since then he learned that it was a fake bottle—it wasn't exactly genuine. Now he did not mean to say that a dynamo that would produce arc lighting, incandescent lighting, and power was a fake dynamo, but if the three kinds of current can be produced as easily and successfully as the gentleman he referred to

seemed to pour out his wine, we as central station men ought to know about it.

W. H. Browne, of the Royal Electric Co., Montreal, said: I presume it is tolerably well known that we have reconstructed our incandescent station and are now operating five dynamos instead of thirty. We have a direct current power service in Montreal; we have an arc lamp service and an arc lamp station. We also have what we call our incandescent station. We have diminished our arc lamp commercial circuit from 350 or 400 private commercial arc light customers to about 125. We have a direct current power service which we have not diminished in any way, but we are serving customers every day with alternating current power service, and our commercial arc service has been diminished by the replacement of alternating arc lamps, so that we have from the same dynamo, the same boiler, the same engine, and the same building, a service of incandescent light, arc lamps and power. That brings up the question that I think Mr. Kammerer's paper directly refers to—the question of a day load and how to get it. We are serving power upon a meter price system; we are asking our customers to pay us for the current they actually use, and not undertaking to serve a flat rate. We have a flat rate price, however, in the nature of a fixed or minimum charge, by which we expect to be repaid the amount of money we have invested, and we make our prices for say 10 horse-power, a certain fixed sum, small, but enough to cover our investment, and we are getting, on that line, nearly as much power service as we can take care of, and not at very low prices either. We are doing this in anticipation of a water power service, and the expectation of having low prices on that account. But at the present time we are keeping up the old motor prices as a basis, and we find the customers perfectly willing to give it. We are serving power from the same wire as the incandescent lights, and we find no difficulty; so that the conjuration of this fake bottle has disappeared.

Mr. Wright said he was aware that it could be done; the question was whether it was practically a success. In Toronto they had services on separate wires, and they would like to get them on the same machines, if they could get steady incandescent lighting while constant draughts were being made on the same dynamos for motor power.

Mr. Fisk said the few motors they were running in Peterboro' did not seem to make any difference with their lighting.

Mr. Milne thought it impossible to have perfect regulation where one had a lot of motors requiring heavy powers. Take, said he, the Edison three-wire system, where an electric elevator is turned on, taking two or three hundred amperes to start with. I defy any system to have a perfectly steady light when we have a load of that kind, and it will be all the worse when the load is less. The variation during a maximum load is very small, but where you have a very small load the variation is considerable; even in turning on a six to twelve horse-power motor you are sure to notice a wink in the light, whether that is caused by trouble in the generator or engine. Suppose it is in the engine, then the trouble is just going to happen as readily with the multiphase as with a continuous system; if the trouble is in the water wheel, it is going to make itself manifest in the light. I do not think it is very feasible to run the whole thing from the one machine, even though you had a separate circuit for the lights and a separate circuit for the power. As long as they are all driven from the one machine you are going to have the same result, because, if it is in the regulation of the engine, it is going to affect the lights. In Toronto, we are going to considerable expense in taking off all these heavy powers from our light circuit, and putting them on what we call a power circuit; at the same time we have been running on the three-wire system for several years, with a day load probably of about 1,500 of 1,600 amperes power load, yet it cannot be said to be extremely satisfactory.

Mr. Browne replied that Mr. Milne had not had direct personal contact with the use of power on a multiphase current circuit with incandescent lights, and went on to say: I presume that many of you here have had theatre circuits on your incandescent lighting system; at least they have in Toronto, where they may have four or five hundred lights in the border lights and the drop curtain lights turned on and off quickly. Four or five hundred lights represent a considerable percentage of the load on that particular circuit, and the cutting on and off of those lights affect all the other lights on the circuit. I presume that is your experience; it has been necessary in my experience in New York city to make a theatre circuit and have nothing else on, so that the lights for the theatres would be only affecting one another. You have precisely the same conditions in a motor power load, but you certainly can regulate for it, if your direct current machine does not regulate for it your multiphase machine has its own regulation. We are turning on and off 40 and 50 incandescent h.p. without affecting our incandescent lighting at all, because by regulation of the machine the variation in the line is controlled. Get enough copper in your line and you can cut on and off 40 or 50 h.p., whether it be motor power or incandescent, and the other people will not know anything about it. The experience I had in theatre circuits taught me that lesson—it is easy to take care of it, and your motor load is no different from your incandescent lighting load. We had so many theatres in New York city that it paid us to make a theatre circuit. In Montreal we have five theatres, and each one of these is on a separate circuit.

Mr. Armstrong: In considering this matter in connection with the heading of Mr. Kammerer's paper, there is another point that has not been touched upon, and which seems to me really more material to the smaller central stations who are at present operating a day load. The main difficulty experienced in working up a power business in connection with the smaller stations is that of the high price of motors, under present circumstances at any rate. There is no doubt that the alternating motor, in the smaller sizes, up to 20 h.p., with the cost of transformers added, is two, three or four times the cost of direct current motors which can be put in, and which do the work; and I think that difficulty has been found to be a very considerable one. There are in Ontario at present 15 or 20 plants using either two phase, monocyclic or three phase apparatus. In connection with these I can only call to mind at the present moment four or five motors which are in actual operation; some of these plants have been running for a year and a half and two years. One I have in mind has been running just about two years and there has been only one motor in operation since the start. If the price of motors had been brought down to about what you can buy a direct current motor at, the people would not long buy the direct current motor at the price it is. You can get around that by adding to your investment the capitalization necessary to supply the motors, but I think, considering everything, that is very doubtful commercial policy. In connection with the operating side of the matter, there are one or two points that I would like to touch upon. The difficulty which Mr. Browne spoke of in connection with his theatre circuits, realized from a change in load, would, I think, be experienced even more severely by smaller stations, becauses I agree with Messrs. Milne and Murphy that the difficulty is mainly a difficulty in the prime mover, especially in the operation of small units. It would seem to me, taking the average small plant, that the stopping or starting of a 10 or 15 h.p. motor would have a considerable effect on a 75 or 100 h.p. engine, and therefore a disastrous effect on the regulation of the lighting. There is another point, and that is, the difference between a direct current and alternating motor, due to the fact that with the alternating motor we have to contend with the idle or wattless currents. I am not aware of any alternating system in which that difficulty is entirely removed.

In reply to Mr. Pepler, Mr. Armstrong said the same difficulty would occur in the case of a railway operated during the day.

Mr. Browne observed that the real difficulty in these cases was that the prime mover, whether a water wheel or an engine, was not large enough for the work.

Mr. Armstrong: It is perfectly correct that for the conditions of railway service we can offer generators which will give a regulation adapted to that service, so that even if the whole load is thrown off instantaneously, it will not effect the service. There is this difference in a railway service, that it has a variation of 10, 15, and 20 per cent. or more in line potential, and the voltage of a railway circuit will run from 550 to 500 volts, and the line voltage will vary even more. But Mr. Browne will admit it is quite out of the question to have any such variation in a lighting circuit, and that was the point I was endeavoring to bring out in my reply to Mr. Pepler's question. The variation in the prime mover, due to the change of speed primarily, is too great to keep the dynamo potential steady enough to permit of a satisfactory lighting service.

Coming to the other side of Mr. Browne's remarks, while there is no doubt weight in what he says, that the difficulty in small plants occasioned by putting a motor on or off is due to the disproportion between the size, say of a 20 or 30 h.p. motor and a 75 or 100 h.p. generator, still I do not think he would propose as a remedy that you should all put in 300 or 400 h.p.

Mr. Reesor said that in a small town a company could not afford to throw away their transformers and get nothing for them, but in a big city the loss would be equalized.

Mr. Kammerer pointed out that his paper distinctly referred to transformer losses, and said that this was being regulated by the reconstruction or rearrangement of the separate stations.

Mr. Farley said it would seem that we had not arrived at that stage where electricians could all agree that all these serivces could be provided for over the same lines by the same dynamo, but for a small company it was very important that it should be done.

Mr. Armstrong: I think there is no person who will question the perfect feasibility and desirability of operating a lighting station (especially a small one), and supplying three or four kinds of service from one generator, one circuit, and one set of appliances all through. There are so many desirable things about such a circuit that it is not necessary to enlarge upon them at all. But the question simply resolves itself into one, that in commercial practice it is not found to be, so far as my experience goes, the easiest to work out under ordinary circumstances.

In answer to a question, Mr. Browne said that in calculating the cost of such a plant, we have two fixed items—the interest upon the capital invested and the labor necessary to produce; so it may be ascertained by any one how much it will cost him to serve light or power. The additional cost will be the amount of coal, oil and waste that he will use up every hour that he is operating his station. When you come to put a day load on there, you do not increase the capital invested if you use the same boilers, the same engines, the same dynamos and the same wire. The capital invested remains the same. You do not increase your labor item, but you may increase your coal burning under your boiler to produce power. Therefore it is easily calculable what your day service is going to cost you and what you can get for it. And the benefit of that day service is that you reduce the proportion of your capital investment and your labor account pro rata through the hours of service that you get power for; that is why power service or day service will pay the station, because you are getting something in return for capital invested and for the labor that you necessarily employ. Leakage from the old style of transformers would be disastrous in this method, but transformers can now be supplied to reduce the leakage from 150 h.p. to 10 h.p. on a 7,000-light plant.

After some discussion on the next place of meeting, it was unanimously decided to hold the convention of 1898 at Montreal.

Wm. Thompson, Montreal, then read his paper on the "Determination of the Heating Power and Steam-Producing Value of Coals from a Preliminary Examination," which, with the discussion on it, will be found in our next number.

At the noon recess, on the invitation of Wilfred Phillips, the manager of the Niagara Falls Park and River railway, the members visited the company's fine power-house, near the Falls.

On resuming, the first business brought up was the election of officers.

J. Carroll stated that L. B. Macfarlane had requested that his name should not be brought up for re-election to office for the coming year, as it would be impossible for him to serve the association as he would like.

After some discussion the following officers were elected: President, John Yule, Guleph (re-elected by acclamation); 1st vice-president, C. B. Hunt, London (acclamation); 2nd vice-president, J. A. Kammerer, Toronto (acclamation); secretary-treasurer, C. H. Mortimer, Toronto (acclamation). Executive Council—F. C. Armstrong, Toronto; J. J. Wright, Toronto; John Carroll, Montreal; A. B. Smith, Toronto; O. Higman, Ottawa; F. A. Bowman, New Glasgow, N.S.; W. H. Browne, Montreal; Wm. Thompson, Montreal; Wilfred Phillips, Niagara Falls; and A. A. Dion, Ottawa.

The usual bonus of $75 was voted to Mr. Mortimer for his services as secretary.

F. C. Armstrong then read his paper on "Why Some Lighting Plants do not Pay," the text of which will be found in another part of this issue. Mr. Armstrong explained that owing to the press of other work, he could not cover the whole field he had mapped out, and was obliged to cut it in two.

Mr. Browne complimented Mr. Armstrong on his paper, which was well thought out and well constructed; but for the purpose of starting a discussion he would take issue with Mr. Armstrong on the question of rates. He found with flat rates that the maximum output is taxed to its utmost, with less result in the income than by the meter system; in other words, by the meter system you are able to get a larger or higher amount in revenue than you can by flat rates. The idea is this: your customer has a certain number of lamps on his premises; your meter ratings every month will tell you the number of hours of consumption; that will tell you whether that man's consumption has been one hour per lamp per day or more. Divide the number of lamps into the number of hours and the number of days, and for the first hour of service charge him your price, and for all the hours beyond that, whatever they may be, a lower price.

Mr. Armstrong: The method Mr. Browne speaks of is, I believe, quite general in England; it is practically giving a discount to the consumer, proportionate to his use of the current during a certain period. It seems to meet the difficulty from one point of view, but my idea in pointing this out was to get the views of the owners of the smaller stations present who have had actual experience. One difficulty I have found in operating the smaller classes of stations in towns of 5,000 or less, is the failure to get sufficient annual revenue at all, on any basis of rates, that will admit of the use of light on the lamp hour basis.

S. Noxon was glad to see Mr. Armstrong had cracked a nut and exposed the kernel on a question of great importance to central station managers. His own company was supplying electricity upon the flat rate basis, and although they had pondered over this matter the objections which seemed to present themselves to us were such that we could not see our way to changing our system. And in this he differed from Mr. Browne in his experience. It was easier to get a customer to pay a uniform rate per month on a flat rate than to get him to pay a large rate per month during the heavy lighting season, and a smaller rate during the summer months, for the reason that the customer's attention is attracted very much more forcibly by the maximum amount he pays.

W. Thompson: I have at present both meter rates and flat rates, and I must say that the flat rates are an abomination to me. When we started in business we undertook to serve current by the flat rate, and in thinking it out it meant a great deal. The ordinary house, with us, gets about from 15 to 20 lights; and the houses being in a residential suburb, are very much scattered. We had to provide alternating transformers and secondary mains. Where we put 20 lights in a house on the flat rate system we had to provide 20-light transformers and also a corresponding capacity on secondary mains. We very soon found that the capital outlay for putting in the extra transformers and secondary mains was going to swell up so much every year, and there was only one way to get over the difficulty, and that was to put in meters. We undertook to do that. The consequence is that on a 500-light machine I am able to put a thousand lights, and during four years I have never seen that machine loaded above 70 or 80 per cent. of its capacity. I venture to say, by cutting off the balance of my flat rate contracts and putting them all on the meter system, I could double that machine and still it would do its work. Not only that, but in one case I have two 50-light transformers working together and there are 200 lights working off that, and in the four years I have not even had the fuse broken. Supposing I had to provide current on the flat rate, with copper enough to carry over that amount of current, 200 amperes, and with transformer capacity enough, why, the flat rates at 30 cents a month wouldn't pay the interest on the capital alone.

Mr. Armstrong pointed out that Mr. Thompson was near Montreal, where city conditions existed. If one could get paid for everything that passed through the meter it would be satisfactory, but measuring the ampere hours does not represent the value of what is passing through your meter.

Mr. Pepler: I may say we had a flat rate, and our great trouble was that with the load we had to carry we had no way of checking the consumption. There is no question, it is easier to deal with customers on the flat rate than on the meter

plan. We are now on the meter system, but it is not altogether satisfactory, and not popular. When you are in the hands of a municipality you have got to consider that question. We are now considering this scheme (partly by way of meeting the demand there certainly is for a flat rate—people say they want to know what they are about; that is the position they take—and partly by way of increasing the number of our small consumers); we are proposing to have a sort of combined plant; to continue the meter plant for large consumers and offer a flat rate to very small consumers, say, five or ten lights, at a certain fixed sum per year. We are also considering the advisability, in fact, we have concluded to do it, not exactly as Mr. Browne suggested, but to make a reduction to large consumers on the meter plan; a discount to consumers of $75, and a still larger discount to consumers over $100.

Mr. Browne thought the difficulty of dealing with customers greatly exaggerated. When the question of complaints from customers came up, he said to his clerks: We will insist upon our station men operating the plant within a reasonable range of pressure, so that we will be able to know that a given number of lamp hours, when burning, should represent a given number of hours of registration; and when we have done that we will say to our customers: If you find any fault with your bill consult your meter. I adopted the plan of making a test for a given number of hours with all the lamps burning, and reading and comparing the number of hours by the registration of the meter. That plan has always succeeded; the man never complained the second time; he was able to go and read his meter, and check it up every day. Not only that, but the managers of large places who are dependent upon their employees for the turning on and off of their light, are able to use the meter to check the consumption by employees. In one case the manager of a large institution had every meter tabulated and had printed forms showing the number of lights connected, and what they were, and the registration of them presented to him every morning, so that he was able to know exactly whether there was any use or abuse of the lighting. The great trouble we find in the business is that our commodity is too expensive. It is a luxury, and our efforts should be to offer it to the public so that they must buy it of necessity, not as a luxury. The flat rate system insists upon a high price as the first requisite, whether the man wants to use the light or not, and he objects. Charging by the flat rate is not honest; it is not fair to the consumer in the summer time, who does not need to burn it, and yet has to pay for it; it is not fair to the consumer in the winter time to pay $10 when he has only used $3 worth. We should cultivate an increased use, not by making a discount on it for the sake of the dollars in it, not because a man's bill is $75 or $100 a month; that is a matter of no consequence; the man that pays you $75 may not be as good a customer as the man who pays you $5. The man who uses your current up a great many hours of the day is the man you want to make the price for, so that he will be obliged in self-defence to buy it. I recommend to the consideration of all here the idea of getting the electric light down to a lower price. I believe that will be the way in which central stations will pay.

Mr. Reesor: I am thoroughly in sympathy with using meters; we are working into the meter system. I quite agree with Mr. Browne that we should make our rates low; people will use more. Just before I left home I closed a contract with a large firm in this way: We put in a certain number of lights in his mill and charge him a minimum rate per year; he thinks he will run all night at times—24 hours a day. They start at six in the morning and run until six at night. Then in the fall of the year they have to light up when it gets dark after six, and then in the morning when they start up they have to light up, putting out the lights at daylight. If they run all night they will use a great deal more current, and the contract is that we charge him a minimum rate per year; if he does not use an ordinary amount of current he must pay so much; if he uses a certain quantity we give him a discount off. We give a discount, in any case, if the account is paid before the 10th of the month. If he uses a larger quantity he gets a larger discount, and we make the rate low. We do the same thing with other customers.

F. A. Bowman: I have been using meters now for about five years; we have flat rates as well, but our object is, as fast as possible, to work our customers on to the meter rates. We take no customer using over four lights on anything but the meter system. My experience is that it reduces the consumption of light. You can over-wire very much more largely when you have a number of meters in than you can under any other conditions. When we make flat rates we base them on what we consider would be a fair average consumption through the year. I know you have to keep constant watch or else you will find them leaving the lights on; you will find some customers leaving lights on every night and all night. I think I saw it stated in an English paper that when lighting residences on the meter system you can depend on the consumption, that is to say, the number of kilowatts going out at any time, as being about 35 per cent. of what you are wired up to. When we give flat rates most of us figure on 16 c.p. lamps whereas on the meter basis we can figure on 5 c.p. and 10 c.p. I might say in this connection that I have rather a unique scheme; I have a small town where I am lighting the streets on the meter system; in other words, we put in an independent circuit, on a three-wire circuit, centred at the Town hall, and they have a meter and switch of their own and simply turn the lights on and off whenever they like. We have no contract with them. As a result, I think they are satisfied. The arrangement has been running about a year and a half now, and they gave me an order to put in very considerable extensions to the system.

H. O. Fisk: In regard to the flat rate system, we ran against a snag that I have not heard mentioned; we started with a contract for 16 c.p. lamps at a certain rate, then 10 c.p. at a certain rate, and we found after a while there were a great many 10 c.p. used. They said they were as good as 16 c.p. lamps. This thing went on for a year or so, the load got tremendously heavy, and the income didn't come up, so we sent an unknown man to investigate. He went around and looked at all the lights, and the result was that about ninety-eight per cent. of our 10 c.p. lamps were 16 c.p. The company then decided they would have no more flat rates for anything except 16 c.p. lamps. With reference to the meter rate, we made a discount about a year ago of 33 1-3 per cent of what we were charging, for all bills paid before the 10th of the month. The result was that by the 10th, or at the latest the 11th of the month, all our bills with the exception of perhaps one, would be paid in cash in the office, and that one you could look out for, because if he didn't wish to take advantage of the 33 1-3 per cent. you could watch him. I might say also that in a year we almost doubled our number of units in that way.

In the course of further discussion, Mr. Browne said: In my personal experience, I had a plant in which we had no residential lighting of any kind; it was entirely commercial business, hotels, saloons, theatres, stores and so on, and the maximum burning at midwinter, in holiday times, did not exceed 60 per cent. of the lights wired on the meter. My experience in residential lighting is, although Mr. Bowman says it is 35 per cent. in England, that it does not equal 30 per cent.: in other words, you will have 1,000 lights wired up and 300 is the maximum burning. Therefore, you are able to serve all of your customers with your 300 light machine, and you are able to get your revenue from the full capacity of that machine.

Mr. Noxon: We have lately put in a thousand light capacity, and I want to know if it is the opinion of those who have had experience that we are safe in wiring up to the extent of 3,000 lights on this machine?

Mr. Browne: If you use the meter basis. If you have residential lighting and commercial lighting together you can easily wire 5,000 lights on a thousand light capacity. In Montreal to-day we have wired up on our circuits 65,000 lights; we are serving those lights with five 300 kilowatt machines, that is, 1,500 kilowatt capacity, and we always have one to spare.

Mr. Armstrong: Those who are in favor of the meter system hold that they are right, and the other gentlemen express themselves with equal confidence. It simply establishes the fact that it is all a matter of conditions. What I contend is, that for plants in towns of from one to three, four or five thousand people—the contract basis has proved itself in actual operation to be very satisfactory. I have in my mind the case of the town of Penetanguishene, where the plant installed was put in some four years ago; it was put in on the basis of the idea which Mr. Browne has just expressed, and which at that time as very clear in my own mind, that the way to make money out of the electric light business was to sell the light cheaply. In establishing the rates a good deal of care was taken to make

the sliding scale equivalent to a meter basis. The result is that that has paid the stockholders very handsomely. The system has been extended as far as the size of the town will permit, and they have some 1,700 or 1,800 lights. A fact that has been established is, that on the basis of charging for lamp renewals you can very largely realize the conditions of the meter plan. With respect to overloading machines they have, up to the present, without any difficulty, been able to operate that number of lights from one 60 kilowatt alternator.

J. M. Browne : I run a small plant in Carleton Place. When we started out we had the idea of putting all the residences and as many of the stores as possible on the meter basis. They did not run very long until they began to kick and said their returns were too light. I came to the conclusion then, that in order to work up a business, it would be better for me to adopt a flat rate right through. We did so and gave a very reasonable rate, and we have, of course, installed more lamps, but I can clearly see that in the near future my plant will be loaded up and I will have to go back to the meter basis or else put in more apparatus. For commercial lighting you should have an assured return to pay for the capital involved, to carry that amount of lighting. For residences I believe it should be run on the meter basis, and on the meter basis only, to be satisfactory to central station men. At the present time we are running them half on the meter and half on the flat rate, and I know for a fact that those who are on the flat rate are using three or four times the amount of light that the other people are, and I am getting very little more money from them.

C. E. A. Carr, of London, then read his paper on "Electric Railways; How to Make Them a Commercial Success."

Mr. Browne : Mr. Carr, from a railway standpoint, has amplified what I think is a necessity with all businesses, namely, good employees and loyal employees, who make themselves interested.

The President then called upon W. A. Johnson, of Toronto, to read his paper on "Accumulators—Their Application to Central Station Lighting and Power." Mr. Johnson's paper is printed in this issue.

J. Farley said that while all the papers had been exceedingly interesting, there was none probably that has a more practical bearing on the future than Mr. Johnson's.

Mr. Browne asked as to the cost of maintenance of the storage battery.

Mr. Johnson : During the three years in which time the modern type of battery has been in use in central stations on this continent, there is good evidence that repairs will not exceed from three to five per cent. of the cost. The manufacturers give a perpetual guarantee that the cost will not exceed 10 per cent. in any case. It has been found in all the more recent stations installed that the companies purchasing have availed themselves of the privilege of doing their own repairs, and if there is any difference between that and 10 per cent. they save it. But there is a definite guarantee of 10 per cent. given in all cases where they expect the plant will receive reasonable usage. I have no further figures than these. I may say, however, that in several plants in Canada these figures have been found to hold good.

Mr. Browne : If it does not exceed 10 per cent. it goes without saying that we must use the storage battery. I have had in mind for some considerable time the utilization of the storage battery in connection with our station. I know the experience with it in New York is that it is satisfactory. The only element which is uncertain is as to the fixed amount of repair in operation.

Mr. Armstrong : The field for the storage battery is unfortunately confined to direct current work. How would you get over that difficulty ?

Mr. Browne : By operating a direct current machine and charging my battery, and in return operating a motor to drive an alternator. I am calculating on having an efficiency of 50 per cent. from the plant. I believe I can afford to do it.

Mr. Johnson : There are a number of cases where alternating current dynamos are operated by water power some distance from towns or cities where the current might be delivered through the city and rectifiers used to charge the batteries or rotary transformers, and the capacity of the generating plant and the transmission line be kept down. The distribution could be handled as easily, perhaps, with the same generators as through the usual alternating circuits ; that would apply especially to a water power that was not large.

The paper by D. H. Keeley, on "Economy in Circuits," was taken as read, and is crowded out of this issue.

Votes of thanks were passed to the authors of the various papers, to Mr. Phillips, of the Niagara Falls Power and River railway, for the efforts he made for the success of the convention; to the various companies that had contributed to the entertainment of the convention, and to the press.

The annual dinner took place on Thursday evening, June 3rd, and Friday was devoted to sight-seeing. Reference to these features will be found under another heading.

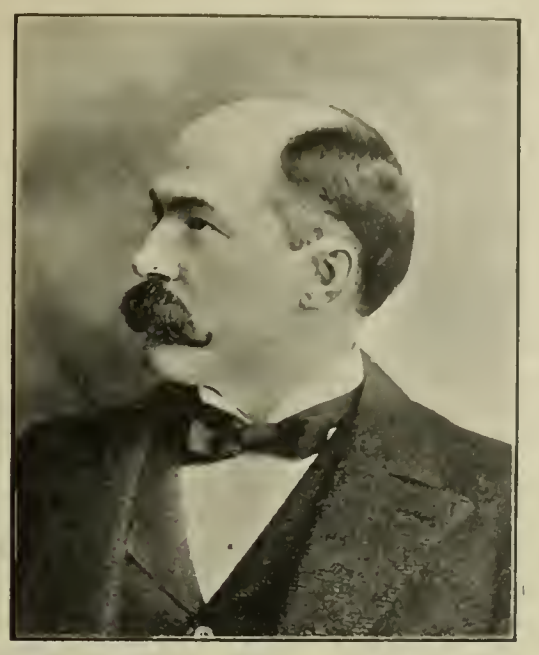
JOHN YULE, PRESIDENT CANADIAN ELECTRICAL ASSOCIATION.

A biographical sketch of Mr. Yule appeared in THE CANADIAN ENGINEER last year.

CHAS. BREWER HUNT, FIRST VICE-PRESIDENT.

CHAS. BREWER HUNT, manager London Electric Company, 1st vice-president of the Canadian Electrical Association, 1897, was born at Windsor, Ont., November, 1849. His first venture in the electric business was in 1878, when he built a private telephone line in London, with two calls upon it, extending from his office, corner of Richmond and King streets, to Hunt City Mills This was the first telephone line doing practical work in London, and was the beginning of a telephone exchange, which was established by Mr. Hunt and several other gentlemen a few months later, and which was sold out at a good profit to the present Bell Telephone Company a year or so afterwards. Shortly after this, Mr. Hunt became interested in a small arc lighting plant, which was started in London by the Royal Electric Company. This being the first electric plant established in that neighborhood, was an object of great interest to all who chanced to see it. Mr. Hunt himself being infatuated with the mysterious working of the electric arc dynamos, decided, in company with his brother, to buy out the Royal Electric Company's interest. This was the starting of the present large and flourishing business carried on by the London Electric Company, of which the subject of this notice is now the manager. Mr. Hunt retains the fullest confidence of all the directors, many of whom

are residents of Toronto. He is also largely interested in the London Street Railway, which was recently converted from a horse to an electric road, and is, undoubtedly, one of the finest equipped electric railways in Ontario. Mr. Hunt takes an active interest in all matters connected with the Canadian Electrical Association, and any member visiting London will, we feel sure, be welcomed by him at the London Electric Company Power House.



J. A. KAMMERER, SECOND VICE-PRESIDENT.

J. A. Kammerer was born at Niagara Falls, N.Y., about 40 years ago. From 1871 until 1891 he was connected with the telegraph and telephone service throughout the United States. He took up electric lighting in 1888. He came to Canada in 1891 and entered the service of the Royal Electric Co., Montreal, in April of that year, as sales agent, and spent a year in Manitoba and the North-West Territories He then came to Toronto, in the interest of the company, and took charge of the Ontario district for about a year, when he was appointed general agent for the company.

COMMENTS ON THE CONVENTION, AND NOTES ON NIAGARA.

The seventh convention of the Canadian Electrical Association was, all things considered, the best yet held, a feature specially notable about it being the large attendance of central station men, and the interest they took in the proceedings.

The re-election of Mr. Yule, though not anticipated in the ordinary course of official changes, is a popular appointment, as he has worked hard and intelligently, and has neglected nothing that he has conceived to be in the interests of the association. Messrs. Hunt and Kammerer, as vice-presidents, will both make excellent officers, for both have good business abilities, as well as a knowledge of the needs of the association.

The members were loud in their praises of the services of Wilfred Phillips, the genial manager of the Niagara Falls Park and River Railway, to whose kindness and forethought the association were so much indebted for the pleasures which have made this convention one to be remembered. Mr. Phillips' services to the association, though so important, were rendered with the modesty that is so natural to him, and the vote of thanks to him, passed at the convention, was no mere formality. Certainly the trip over the Niagara Falls Park and River Railway was one that will not be forgotten by the visitors.

There is not a foot of the route traversed by the Niagara Falls Park and River Railway from Queenston to Chippewa that does not present some scene that has a charm to the traveller. The wonders and beauties of Niagara are not to be realized in a day, and the scenery along this favorite route cannot be fully appreciated in one trip. Indeed one of the oldest residents at the Falls observed to the writer that he never goes up and down this wonderful river without making some new scenic discovery that charms and surprises him. In this respect the Canadian side of the river is remarkable; and while about two-thirds of the water of the whole river pours down on the Canadian side, it is also true that two-thirds of the great natural features about the Falls are to be found on Canadian territory. While this is true, it must be admitted that because of superior energy, combined with other causes, the Americans have made far greater commercial use of their opportunities than we have. The engravings we give in connection with these sketches illustrate this remark. We have all the grand natural scenery, they have the big hotels and the business that flows from them; we have most of the water power, they monopolize nearly all that has been developed. The Niagara Falls Park and River Railway are the only users of power from the Niagara on the Canadian side, and they, unfortunately, are not permitted under their charter to sell power or use it for other than their own railway requirements. Readers of THE CANADIAN ENGINEER are aware that the vast water-power on the Canadian side has been tied up by an unfortunate bargain with the company known as the Canadian Niagara Falls Power Co., composed in reality of members of the Cataract Construction Co who own the big electric power works on the American side. It will be remembered that this company recently applied for an extension of time in which to complete their power works on the Canadian side, and if this time had been granted it would have tied up the Canadian power development for another period, and fastened a most undesirable monopoly on the Province of Ontario—for it is a question whether any independent company would have the right to take water from around the Canadian Falls if the conditions made with the so-called Canadian company had been fulfilled Indeed, as matters stand, the claims of another company who propose to draw water from the Welland (Chippewa) River by a canal and discharge it under the Park grounds just below the falls, have not yet been determined Quite recently this question was brought before the Ontario Court of Appeal for an opinion as to the status of the parties, but the promoters of the Welland River scheme, known locally as the "Canal scheme," withdrew the reference to the court, apparently preferring to start in and take their chances of a favorable interpretation afterwards. Having already made preliminary surveys, they last month started a few men on digging a ditch above the falls, and a representative of this paper was informed that an announcement of their plans would be made in a short time. This scheme is not to be confounded with that of the Cataract Power Co promoted by John Patterson, of Hamilton, who proposed to convey water to a point near De Cew's Falls and carry electric power thence to Hamilton. Meantime the American syndicate, who counted easily on the Ontario Government granting the delay asked for, but who have been informed that the works must be completed as first agreed by November 1st, 1898, have been digesting plans by which they can save their charter and the $25,000 rent they have been paying to the Queen Victoria N.F. Park Commission since 1892. Engineers have staked out the site, borings have been made through rock that is to be pierced by the big shafts, and it is said that the new machinery for carrying out the work will be on the ground from the United States next month. So, between the two or three schemes pending, we may at last look for the building of the great industrial enterprises that should have been commenced long ago on the Canadian side of the world's greatest water power.

Meantime the only existing power we can boast of is that owned by the N. F. P. & R. Railway, views of whose power house are given herewith. It has a capacity for 3,000 h.p., of which 2,000 h p. have been put in. The present power is provided by two wheels of 1,000 h.p each, built by Wm. Kennedy & Sons, of Owen Sound. There are three Canadian electric generators of 200 K.W. each, the company still using also its steam power generators at Queenston to surmount the steep hill there. The electrical installation was made under the superintendence of Mr. Phillips, who was then the electrician of the road, and everything works with admirable smoothness. The construction of the road, which is 13½ miles long, reflects great credit on W. T. Jennings, C.E., Toronto, who supervised the work. It is well ballasted, with heavy ties and heavy steel rails, and guard rails are placed wherever the track curves near the river bank. The cars are exceptionally strong, with solid steel 33-inch wheels, and heavy steel axles. Some cars are built with three tiers of seats running longitudinally, so that all passengers can view the scenes below without rising from their seats.

The business of the Canadian convention closed by a banquet at the Dufferin Cafe. The dinner was excellent and was well served, and the arrangement of the whole programme reflected much credit on the committee, which was composed of E. E. Cary, chairman; F. C. Armstrong, C. B. Hunt, W. Phillips and A. B. Smith. After the Queen had been loyally toasted, "Our Guests" was proposed and replied to by James Wilson, of the Niagara Falls Park Commission; Mr. Lincoln, of the Cataract Construction Co., and James Innes, ex-M.P. of Guelph. Mr. Wilson referred to the attractions of Niagara and pointed to the great electrical works on the American side as a foretaste of what might soon be expected on the Canadian side. Mr. Innes in his speech paid a compliment to the ability and energy of the chairman (Mr. Yule). He remembered, as a press man, coming down to see the first coal oil lamp, which seemed a remarkable advance in the progress of house illumination, but no one seemed to conceive then of the wonders of electric lighting. "The Electrical Industries" was replied to by W. H. Browne, of Montreal, who looked forward to the time when this association would no longer be limited to questions of electric light, but when heat, power and chemical work would come in for an equal share of

attention—for there was a tendency to transform electricity into all forms of power. He was associated with what was probably the first electric railway in the world—in Virginia in 1887—when there seemed but little probability of the present attainments in electric railway operations; but now that the experiments of the N. Y. and New England railway with the third-rail system had proved so successful, it was quite possible that within another five years the steam locomotive would be practically superseded by the electric one. Even now the G.T.R. contemplate the operation of all their lines around Montreal by electricity. The ease of transportation is bringing the country into the city and giving the city access to the country, and the next step is the carrying on of farm work by electricity, and then we shall have the horseless era. The time was not far off when cooking and the commoner forms of labor will be done by electricity, so that lighting will be the least important branch of the electrical field. There was a great opportunity for the young to study this great power field. H. P. Dwight, of the G.N.W. Telegraph Company, also replied, giving interesting reminiscences of the early days of the telegraph. After letters of regret were read from absent friends, the toast of the "Ladies" was responded to by F. C. Armstrong, in a humorous speech, and the "Press," the last toast, was replied to by W. J. Johnston, of the *Electrical World*, New York. Mr. Johnston told how his paper was first started 23 years ago under the name of the *Operator*, and came into existence to represent the interests of telegraph operators. The paper followed the advances and changes of electrical work, until now few would trace the relationship of the present volumes to those of its humble beginning.

The miniature incandescent lamp formed into a scarf pin, distributed by the Canadian General Electric Company, was the best appreciated souvenir of the convention, and the demand was much greater than the supply. At the National Electric Light Association's gathering on the New York side there were souvenirs in abundance, from lead pencils and paper weights to sections of cable and chunks of carborundum; but wherever THE CANADIAN ENGINEER man went with his miniature lamp displayed on his badge he was asked, "Who's giving out that lamp?"

Speaking of carborundum and the American convention, the special industries gathered round the water power district of the American Falls are an interesting sight, and an object lesson to Canadians, who are allowing time and opportunity to slip by in the development of like Canadian industries. Some of these American factories are kept strictly closed to visitors who have not some special "pull" with the owners, but others are freely open. There are the big aluminum works of the Pittsburg Reduction Co., the Carborundum Works, the Calcium Carbide Works, the works where the electrical production of soda and other chemicals is carried on, the Mathieson Alkali Works, and there are paper mills, pulp mills, lumber mills, foundries, all of which have combined to double the population since 1890. The latest of the large special industries to be established here is the American branch of the Oldbury Chemical Company, near Birmingham, England, who are large manufacturers of electro-chemical products and who have two and a half acres of ground for their new plant now being erected. In this connection it must not be supposed that the Cataract Construction Company are the only developers of power here, for the company known as the Niagara Falls Hydraulic Power and Manufacturing Co., supply eight concerns with water-power, ten concerns with electric power, and two with mechanical power furnished from their shafts. This company was in existence years before the Cataract Construction Co., and have a canal of their own through which water is led from above the falls sufficient to generate 150,000 horse-power, of which about 40,000 horse-power is now developed and used. A view of the river bank displaying some of the cataracts from their discharge pipes and tunnels is shown in this issue. The hydraulic engineer of this company is W. C. Johnson, of Niagara Falls, N.Y., who has made a special study of hydraulics and who has solved many difficult problems in the erection of various works here. Through the courtesy of Mr. Johnson, our representative was shown through the various factories where these problems have been worked out.

On Friday morning, before the members started out on their sight-seeing jaunt, they were greeted with a summary report of the convention, which Mr. Mortimer, with commendable enterprise, had compiled, one page being devoted to humorous skits, which were taken in good part by those who were "skitted."

To the Toronto members one of the pleasantest features of the convention was the trip across the lake and back by the Niagara Navigation Co.'s fine steamers. It seems like getting into a new country to face the cool and appetizing breezes of that grand old lake, and everybody enjoyed the trip as if it had been their first.

Then there is the Niagara Falls Power Company, associated with the Cataract Construction Company, having a tunnel of 100,000 h.p. capacity, and a second tunnel which will yield 150,000 h.p. So that the American power works, when developed, can supply 400,000 h.p. It may here be noted that the three tunnels contemplated by the Canadian Niagara Falls Power Company would yield a total of 350,000 h p. The N. F. Power Company have so far laid out about $7,000,000 in plant and property on the American side, but have bought no land on the Canadian side, except for the immediate works of the Can. N. F. Power Co The N. F. Power Company now supply hydraulic power to one company to the extent of 7,200 h.p., and electric power to 21 companies to the extent of 14,695 h.p., besides the 5,000 electrical h.p. they send to Buffalo, making a total of 26,895 h.p. which they now furnish. Besides their large interests in Niagara Falls city, they own the suburban village of Echota, which they are building up, and the houses in which are all rented at a reasonable price, which always includes water supply and electric light. The power furnished from their three big dynamos of 5,000 h.p. each (described in a former number) has of course all been taken up, and the company are pushing ahead with excavations for seven or eight new wheel pits, so that it will probably not be long before the whole 50,000 h.p., for which this power house is planned, will be taken up.

Among the most interesting of the special industries of this place is the works of the Carborundum Co. What is carborundum? It is made by four s's—sand, sugar, salt and sawdust. These simple materials are mixed and fused in an electric furnace at a low heat, and the result is carbide of silicon, or carborundum, which is a mass of crystals as hard as diamonds. They are in effect artificial diamonds, and their commercial use is as an abrasive. The crystals after being reduced to all grades of fineness are mixed with porcelain or other material, and made into cylinders, discs, straps, boards and blocks for use in grinding and polishing, from delicate dental and jewlery work to the coarsest machine and tool work. For these purposes it is fast superseding emery and corundum, for though dearer to begin with, it is vastly superior in life and efficiency. The company started recently with capacity to produce 300 lbs. per day, but so great has been the demand that they are now turning out 10,000 lbs. per day; and the 1,000 horse-power which they are now using requires to be doubled to 2,000 h.p. More than this, the company are now preparing to equip a branch plant in Canada, of which THE CANADIAN ENGINEER will give particulars later on. Reserving a detailed description of its manufacture till then, we may observe that carborundum is both infusible and insoluble—neither oils, water nor acids affect it. Even hydrofluoric acid, which dissolves all the silicates—does not eat it. The colors of the crystals as they come from the furnace vary from pale greens to cobalt blues and violets, and their sheen is beautiful beyond description.

The Pittsburg Reduction Co. started the manufacture of aluminum at Niagara Falls in 1895 with 1,500 h.p; now they have two establishments here, using over 6,000 h.p. The direct electric current is essential to the making of aluminum, so that this is likely to be the headquarters of this industry. Indeed, it is understood that this company, while controlling the entire output of the United States, are now securing control of the European market, and would so rule the world's product of this metal, as the Standard Oil Co. does that of petroleum and its products. While the output of aluminum is steadily increasing, the reader should be informed that a great many of the uses for which it has been so highly lauded have been proved to be impracticable. Some enthusiasts imagined that aluminum was to supersede every other metal under the sun, and when its failure was demonstrated to the cost of experimenters in many lines, it has got a "black eye" in other quarters where it did not deserve it. The fact is that aluminum has a low melting point, and for uses where the metal is subjected to intense or prolonged heat, it is a failure. It is successfully used to make many articles of household use, such as cooking utensils and articles in which lightness is an object, and a factory exists near the Reduction Company's works that is turning out large quantities of such articles. Among the items which the Reduction Company put in their price-list are ingot, in pure aluminum and in alloys, but it is noted that the metal is not suited for alloying with brass or zinc, though a special casting is made as a substitute for brass. These ingots range from 31 to 42 cents per lb., and aluminum castings at 45 cents per lb. upwards, according to circumstances. Rolled rods, wire plates and sheets are made at corresponding prices. Under certain conditions aluminum wire is being successfully used instead of copper wire for the transmission of electricity.

After an interesting trip over the "Gorge Route" electric railway, on the American side, the Canadian convention came to a delightful close by a run into the foot of the cataract on the steamer "Maid of the Mist," by courtesy of the genial Capt. Carter, whose own trusty hand was at the helm.

The American convention (National Electric Light Association), from June 8th to 10th, was characterized by the usual vim and bustle of our cousins across the border. The International Hotel was a humming throng each day, and numerous exhibits, which could not be placed in one room, were scattered among the private apartments of the hotel. It is to be hoped that the day will come when the Canadian electrical interests will also be able to make a good exhibition as a feature of the convention. To us the American convention had a special interest, derived from the fact that a Canadian, who had sat on the council for five years, during which he had been elected successively to the second and first vice-presidencies, was now in the sixth year sitting as president over the most influential electrical institution in the Union. And a very able and diplomatic president he made, as was generously conceded by the technical press. The selection of him was an honor to Canada, and not to Mr. Nicholls only.

In his presidential term, Mr. Nicholls introduced the idea of interim presidential messages, which may well be adopted by presidents of other bodies. Whenever any question of importance cropped up he did not wait till the annual meeting, but sent out a message to the association giving information, or soliciting or giving opinions on the subject. Where members of an association are scattered over a wide geographical area, and special meetings are inconvenient and expensive, the plan is a good one.

The photo from which the engraving at the head of our convention report is made, was taken by G. W. Whitaker, the skillful photographer at the Hotel Lafayette, which was the headquarters of the Canadian convention.

One of the instructive sights to the visitor interested in engineering is the new steel arch bridge over the Niagara, replacing the old suspension bridge at Clifton, about which we hope to give something in next issue. The new bridge is built below and around the suspension bridge, so that when the cables of the old were removed it rested on the new structure, which will be finished without interrupting the railway traffic a single hour. The work will perhaps be finished by the time these pages are in the hands of the reader. The wires which form the big cables of the old bridge were perfectly sound, and it is understood they have been bought up by a Montreal firm to be manufactured into wire nails.

Speaking of bridges, it is understood that the new upper suspension bridge near the falls will be at once replaced by a new steel arch bridge, if the tenders now under consideration for the project are not too high. If built, the arch will describe a parabolic curve, and will be the largest span in existence, being840 feet, or 200 feet larger than that of the one at Clifton. A condition of the contract is that the bridge should be completed by the end of March, 1898. The plans provide for a double track electric road, as well as for a carriage way and road for foot passengers. One proposition is to take the materials of the present suspension bridge and build a suspension bridge on the site of the old one just above Queenston, the stringers and pieces of which now dangle weirdly in mid-air. This would connect the Gorge route with the Canadian Niagara Falls Park and River Railway at both ends, and by interchange traffic form a belt line which would be very convenient for the tourist, and could be made as profitable for the two companies

THE REVOLVING FIELD TYPE OF ALTERNATING CURRENT GENERATOR.

The development of the revolving field type of alternating-current generator and the standardization of a complete line, both for the monocyclic and three-phase systems, has of late occupied the attention of the engineering department of the General Electric Company with successful results. The alternators are designed for the standard frequency of 60 cycles and for pressures ranging between 500 and 5,000 volts.

The machines are built on the same lines as the Canadian General Electric type of induction motor. The stationary armature is built up of laminations stamped from specially selected and tested steel plates. Ample spaces are left for ventilation, and the coils are covered and protected by shields. The base of the armature is of smooth cast-iron and the pedestals supporting the bearings are provided with spherical seats, which support the boxes and allow of perfect alignment.

The removable bearings are, of course, self-oiling, with the oilways so cut as to give an even flow of oil from the resting places of the rings in the shaft to the end of the bearings where the oil returns to the reservoir.

The revolving field is extremely simple of construction. It is merely an iron spider mounted on a shaft carrying a soft-steel ring, serving as a yoke for the pole pieces, which are made up of laminated iron with polar projections. The field coils are removable, and in the larger sizes are wound with flat copper strips placed edgewise to allow of free egress from the coils of any heat. The armature can be moved along the base to facilitate access to fields and armature winding.

With a high efficiency, these alternators combine good inherent regulation, and can be, if desired, compounded for accurate automatic regulation. Such compounding in certain cases is not necessary to convenient operation, and may be omitted. When compounded a commutator is mounted on the shaft and rectifies current supplied from a series transformer in the main circuit. These compounding devices are not, however, included in the generator, properly so called. They come

The Revolving Field Alternating Current Generator

under the head of extras. The temperature of the armature and the field windings does not rise above 45 degrees centigrade above that of the surrounding atmosphere.

The new type of generator is not, of course, intended to displace the revolving armature type. The revolving field type has its own special field of usefulness. It is free from high-potential collector rings and commutators, the only collector rings being the two used to bring the exciting current to the revolving fields. The high-potential part of the alternator—the armature—being a stationary structure, can, it is claimed, be wound and insulated for much higher pressures than is desirable for revolving armatures, and the current can be fed directly into the line without the intermediary of step-up transformers. All the high-potential terminals are effectually insulated.

The revolving field alternators can be wound for the two-phase system when desired, and when so wound are so arranged that armature coils can be cut in or out to give independent regulation of the two phases.

During the past year the Canadian General Electric Company has sold a number of machines of this type, some for belt drive, but principally for direct connection to water wheels and steam engines. The illustration shows a 750-kilowatt, 40-pole, three-phase machine, running at 175 revolutions and delivering current at 4,400 volts. It is one of 12 which will be used on the Lachine Rapids installation.

Two more generators of the same size and type are being constructed for the 30-mile transmission plant of the West Kootenay Power and Light Company. For very low potential work this type is especially well adapted, two machines of 150 kilowatts capacity each having been in use for several months in the works of the Willson Carbide Company at Merritton, Ontario.

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THE PUBLISHERS.

FREDERIC NICHOLLS, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

We noted in our issue of one year ago the election of Frederic Nicholls, second vice-president and general manager of the Canadian General Electric Co., to the presidency of the National Electric Light Association of the United States, which is numerically and otherwise the most powerful organization in the world devoted to the furtherance of electrical interests. It was to be expected by those who are acquainted with the personal force and executive ability which Mr. Nicholls brings to bear on the many business enterprises with which he is identified, that the affairs of the National Electric Light Association would under his *regime* be conducted with characteristic energy. The main difficulty with all associations of this kind is to maintain the serious interest of the members in those matters of current importance to deal with which as an organized body is their apparent reason for existence. In practice innocuous desuetude during three hundred and sixty-two days in the year, and a junket for the remaining three, is only too apt to be the actual *modus operandi*. The National Electric Light Association has admittedly suffered from this tendency in the past, but the improvement visible for the past few years has culminated under the presidency of Mr. Nicholls in a year of serious effort to deal with matters of vital moment to the electrical industry, and more particularly in the proceedings of the convention just closed at Niagara Falls, admitted on all sides to be the most successful in the history of the association.

The papers read before the convention were in most cases statements by recognized authorities upon topics of special interest. Amongst such may be mentioned the paper by Professor Elihu Thomson, on "Arc Lighting"; that by Arthur Wright, of Brighton, Eng., on "Profitable Extensions of Electricity Supply Stations"; that by Mr. Scott, on "Rotary Converters," and the lecture by L. B. Stillwell, on the "Application of Niagara Power." The attendance at the convention was the largest on record, reaching a total of over one thousand, and the proceedings throughout were of a most animated and interesting nature.

The American electrical press, in speaking of the convention, does so in terms which are highly complimentary to Mr. Nicholls as president of the association. We quote from the *Electrical Engineer*, of New York, as follows:

"In every respect the convention of the National Electric Light Association, at Niagara Falls last week, must be regarded as a great and brilliant success, far beyond that which was expected by those who had worked hardest to secure a happy result. The attendance was large; the papers were excellent and timely; the devotion to work was exemplary; harmony prevailed; the weather rang the changes so that the Falls could be seen in every aspect, and a good choice was made of officers to carry out the programme of usefulness to which the association has for some years past so consistently pledged itself. President Nicholls retired from office in a literal blaze of glory."

The *Engineer* further says. "To President Nicholls the association is under the deepest obligations for his devotion to duty and his skillful guidance of its affairs, and his term of office will always stand out in bright relief, no matter how much good work precedes it, nor how earnestly his successors strive to leave a brilliant record also."

Electricity, of New York, speaks thus: "President Nicholls made a model and dignified presiding officer. He far eclipsed his previous efforts, and it will be a high compliment indeed to any of his successors if it can be said of him that he equalled Mr. Nicholls as a presiding officer."

The *Western Electrician* of Chicago, in an article on President Nicholls' administration, believes that "it has been a great many years since the National Electric Light Association has had such an energetic president as the occupant of the office at this time, and it is but fitting in the closing days of his administration to call attention to the excellent character of the work he has done and the value of the service he has contributed to the association."

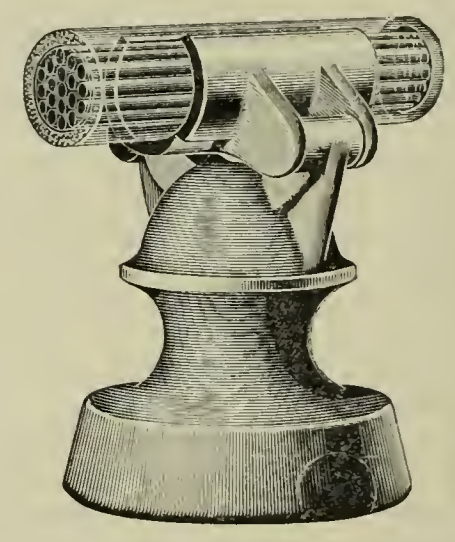
The *Electrical World* refers to the general character of the convention as follows: "While the social features and minor gaieties which characterize all conventions were not forgotten in this instance, the gathering was generally commented upon as the most business-like meeting that has yet been held by the association. The discussions of some of the papers were more than ordinarily valuable in bringing out the views of men whose opinions are entitled to respect, while the papers themselves were of a class calculated to instruct as well as to edify those who heard them. It is a pleasant task to be thus able to sum up the twentieth convention as the best in the history of the association, and still more pleasant to be able to prophesy that from all indications the twenty-first convention will be still more valuable and attractive to those who may have the pleasure and privilege to attend it."

The *Electrical Review*, of New York, has the following to say: "The success of the association during the past year under the wise and enterprising management of its retiring president, Frederic Nicholls, has been marked, highly satisfactory to all concerned. The administration has been at all times vigorous and well directed."

Altogether Mr. Nicholls in person, and the electrical public in Canada generally, have reason to feel most gratified at the manifest approval with which our American friends have greeted the occupancy on part of a representative Canadian of the president's chair of their most important electrical organization.

TOGGLE-CLAMP FEED WIRE INSULATOR.

The usual method of attaching feed wires for electric railroads and electric light wires to their insulators consists in the use of a binding wire, a loose screw cap or hammering over the fingers which are furnished on either side of a groove in the top of the insulator. The use of a tire wire necessarily requires time and the risk of abrading or cutting through the insulating covering of the wire. A screw cap is liable to fall from the hands of the lineman or to cause other trouble on account of its size and nature. The hammering over on the wire of the metal retaining fingers is not to be considered good practice for the reason that the fingers are usually so stiff and brittle that in case the wire has afterwards to be removed the fingers are with difficulty opened or break off in the effort. The "toggle-clamp" feed wire insulator has been designed to provide an instantaneous fastening for the wire, with none of the disadvantages just mentioned, and every advantage in the way of instant removal without injury to the wire. The construction consists of two hinged parts as shown in the cut, so arranged that the



weight of the cable causes the two jaws to come closer together with a powerful toggle action. To insert the cable the jaws are opened by an upward movement and the cable is dropped into place. No other fastening is necessary. The cable is removed by simply lifting it out of the jaws, thus saving a great deal of time in installing, or shifting a line. The moulded insulation is protected with a malleable cast iron casing completely covering the exterior surface of the insulator. The toggle-clamp cable insulator is manufactured by the H. W. Johns Mfg. Co., 100 William st., New York.

METAL IMPORTS FROM GREAT BRITAIN.

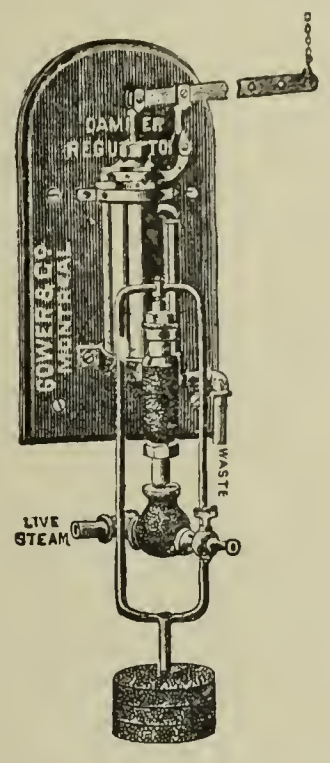
The following are the sterling values of the metal imports from Great Britain for May, and the five months ending May, 1896 and 1897:

	Month of May,		Five months ending May,	
	1896.	1897.	1896.	1897.
Hardware and cutlery	£6,097	£7,730	£27,493	£25,647
Pig iron	3,179	563	7,780	1,018
Bar, etc.	2,141	316	6,299	4,205
Railroad	9,675	6,935	22,038	20,286
Hoops, sheets, etc	5,481	5,436	11,696	16,445
Galvanized sheets	3,006	3,975	15,672	15,998
Tin plates	13 753	8,652	56,119	80,972
Cast, wrought, etc., iron	6,776	3,882	21,568	14,965
Old (for re-manufacture)	2,680	. ..	3,061	572
Steel	10,590	3,493	36,727	18,480
Lead	1,182	1,672	5,443	4,454
Tin, unwrought	1,559	1,609	7 074	8,925
Cement	3,393	1,825	10,365	4,778

THE International Luxfer Prism Company, Chicago, Ill., has been incorporated under the laws of the State of Illinois, with a capital of $1,000,000, commencing with $500, to manufacture and deal in iron, building materials, etc. John M. Ewin, Wm A. Illsley, and W. M. Sturgis, Chicago, Ill.; Thos. W. Horn, Toronto, Ont.; W. H. Winslow, River Forest, Ill., are the incorporators.

AUTOMATIC DAMPER REGULATORS.

Hitherto the high price of these and the cost of delivery and high customs duty have all tended to prevent the spread of this useful appliance in Canada that it deserves. Gower & Co., Montreal, are now, however, introducing on to this market a damper regulator for steam boilers at the reasonable price of $60, which is somewhat about half the price of those that have been put before the steam users up to the present. The advantages of a damper regulator are manifold. It adds to the life of the boiler, keeping the expansion and contraction more uniform. It keeps a steadier stroke on the engine. It can be absolutely relied on as a safety valve. It saves coal and can always be depended upon at night or by day, and eases the mind of the fireman, who, in many cases, has his coal pile many yards away from his boilers. Messrs. Gower & Co.'s regulator is warranted to operate the dampers of any size on a variation of but one pound pressure. So that if the damper is of ample size the boiler pressure will never vary more than one pound. It is actuated entirely by steam and has but



one connection to the boiler and no water connection. There are no complicated parts, the only movable parts being two pistons; one small, controlling steam to the larger one. The regulator can be taken apart and cleaned by any fireman or engineer. Messrs. Gower & Co. are well known as the Canadian engineers and representatives of the celebrated Green's Fuel Economizer, and we feel sure that the firm make sure of the excellence of any machinery they put on to the market.

WATER DRIVEN PLANTS.*

BY JOHN MURPHY.

As close regulation is the most important point in the operation of any electrical plant, I will endeavor to show how this can be accomplished best in a water-driven plant, and, as so much depends on the manner of installation, I will dwell for a moment on the importance and method of properly equipping the water wheel gate. I take it for granted that the water wheel itself was placed in position by a competent engineer, due provision made to cope with low water, anchor ice, and the many other troubles inherent in the use of water power. This having been done the gate and all its connections, from the water wheel to the hand wheel in the dynamo room, should be so constructed as to move quickly, positively and easily, so that the instant the regulator is actuated by a variation in speed the water wheel will receive its greater or lesser supply of water and thus be enabled to maintain a constant speed. An arc plant with its automatic current controllers, driven by a water wheel equipped as indicated above, will run for an indefinite period with little or no attention, but incandescent lighting and power machinery require somewhat more supervision. I hold it is a mistake to attempt to supply power from a lighting circuit except in very small units. One of the greatest recommendations for the glow-lamp as an illuminant is its steadiness, but this quality is almost unknown when motors which are frequently started and stopped are run on the same circuit. The separately driven exciter is a great boon to water power users whose loads are subject to great variations. Its many advantages are so apparent that it seems unnecessary for me to do more than merely mention it in passing. Another arrangement, the utility of which speaks for itself, is the automatic field controller, which strengthens or weakens the generator field circuit according as the potential on the line falls or rises.

An incandescent lighting plant requires a certain amount of hand regulation, although the apparatus just referred to is useful, within certain limits. All hand regulation necessary on a lighting circuit should be done, figuratively speaking, as far away from the lamp as possible; in other words, it is the field circuit of the exciter that should be varied when it is necessary to change the potential on the line. The exciter field rheostat should be of large range and divided into a great many sections, so that the movement of the rheostat-arm from one point to another would cause such a slight change in field current as to make a scarcely perceptible difference in the brilliancy of the lamps. Where large generators are used and many circuits are run, the use of the individual circuit regulators becomes imperative.

I wish to call your attention to two pieces of mechanism. The first device is an automatic speed indicator and alarm which points out the speed at which the machinery is running, and also rings a bell at every change of speed. The other is to close the water wheel gate the instant the speed rises above a predetermined point. It consists chiefly in a pair of friction pulleys mounted on a frame. One of the friction pulleys is continuously driven from the machinery to be controlled, and the other is connected to the gate-closing apparatus. These friction pulleys are normally placed apart and are brought into contact by a weight or spring, which is released by a lever attached to a pair of governor balls. The instant the speed rises a certain percentage above the normal, the governor balls move the lever, and the weight or spring being released, the frictions are pulled together and the gate is immediately closed.

It would hardly seem correct to leave the subject of the operation of water power plants without at least mentioning that bane of water power users—anchor ice. If wheels are favorably situated, that is, if they are supplied from a large pond in which there is little or no current, and if there is an overflow or by-wash into which most of the floating ice can be diverted, by extreme watchfulness a complete shut-down can be prevented. But, if the wheels have no still pond from which to draw their water supply, it is prudent to resort to the auxiliary steam plant as soon as there is the least suspicion of anchor ice.

* Abstract of a paper read before the Canadian Electrical Association.

JUBILEE FOUNTAIN FOR MONTREAL.

It was a happy inspiration which moved Mr. Macaulay, of the Sun Life Assurance Co., to present a drinking fountain to the City of Montreal, as a memorial of the Queen's Jubilee. The accompanying illustration is a sketch reproduced from the *Witness*, of the proposed

SUN LIFE ASSURANCE CO.'S FOUNTAIN.

fountain, which will be a granite block surmounted by the figure of a sleeping lion, and having the inscription, "A tribute to Her Majesty, Queen Victoria," with the dates 1837-1897.

DYNAMOMETER.

Editor CANADIAN ENGINEER.

SIR,—Kindly inform me if there is a car coupler that will test the draft of a locomotive, giving the draft in pounds. Where can it be got?

J. W. VAN NORMAN.

Peterboro, Ont., June 5th, 1897.

The apparatus you refer to is usually known as a Dynamometer and there are a number of them on the market. If you were to enquire of any of the leading makers of testing machines, as the Riehle Bros. Testing Machine Co., Philadelphia, Pa., they would be glad to afford you all the information possible on the subject.

THE KINGSTON, ONT., SCHOOL OF MINING.

Editor CANADIAN ENGINEER:

SIR,—Kindly correct a mistake in your report, in a recent issue of your paper, of the number of students attending the School of Mining, Kingston. The number 502 as given in THE ENGINEER includes the 300 students who attended the ten outside classes. Thus, the total number of students attending classes in the School of Mining is 202. Long before it reaches 502 we shall need larger buildings.

I remain, yours, etc.,

W. L. GOODWIN.

FIRES OF THE MONTH.

June 1st.—W. S. Stewart's planing mill, etc., Lucknow, Ont., also electric light plant. Loss, $15,000.——June 1st.—Carriage factory belonging to S. Siggins, Woodstock, Ont. Loss, $5,000.——June 3rd.—Firstbrook's box factory, Toronto; damages amounting to $200.——June 8th.—Cossit's foundry, Brockville, Ont., fire started in painting department. Fully covered by insurance.——June 12th.—Davidson & Campbell's planing mill, Niagara, Ont. Loss, $15,000.——June 15th.—Part of the east end abbattoir, Montreal. Loss, $35,000.——June 16th.—Canning factory at Tiverton, N.S. Loss, $3,000.——July 4th.—Fenderson & Co.'s saw mills, Sayabec, Que. Loss, $30,000; insurance, $8,000.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Kingston branch No. 10, C.A.S.E., has elected and installed the following officers for the current year: President, Fred. Simmons; vice president, Charles Asselstine; secretary, John L. Orr; treasurer, Charles Selby; conductor, Wm. H. Woodrow; door-keeper, Robert Bajus; trustees, Past President Sandford Donnelly and Jas. Blomley.

At the June meeting of Toronto No. 1, C.A.S.E., held in Engineers' Hall, the following officers were elected: President, Geo. C. Mooring; vice-president, Thos. Eversfield; rec. sec., John W. Marr, 28 Grant street, Toronto; financial sec., John G. Bain; treasurer, Samuel Thompson (acc.); conductor, George W. Thompson; door-keeper, T. Cadwell.

Arrangements are progressing for the forthcoming convention of the Canadian Association of Stationary Engineers at Brockville. By the constitution the convention should be held on the 17th and 18th August, but the date may be changed a day or two later, owing to arrangements that are being made for a special illumination of the islands. The exact date will be announced in our next number.

Albert E. Edkins, the popular inspector for the Boiler Inspection and Insurance Co., is slowly recovering from his recent serious illness, though not yet able to resume active duties. His many friends in the C.A.S.E. will be glad to see him among them again.

The Steam Boilers Act, which was a bill before the Dominion Parliament to provide for the examination of stationary engineers and the inspection of steam boilers, promoted by the members of Canadian nd Ontario Associations of Stationary Engineers, has been laid over till next session.

The following officers have been elected for Montreal No. 1, C.A.S.E.: President, Wm. Smyth; 1st vice-president, J. M. Boden; 2nd vice-president, P. McNaughton; secretary, Jas. O'Rourke; treasurer, J. E. Jones; conductor, J. Glennan; doorkeeper, J. Wilson; trustees, John J. York and Geo. Hunt

An association called the Railway Men's Air Brake Club has been ormed among the G.T.R. employees at Sarnia, the principal object of which is the study of the air brake. J. B. Wilson is president and Ed. Everett, secretary, and the association now numbers about 75 members, though it has only been in existence about five months. A similar organization called the G.T. Air Brake Mutual Association has been formed in London, Ont., with Thos. McHattie as president and Geo. Black, secretary.

ELECTRIC RAILWAYS—HOW TO MAKE THEM A COMMERCIAL SUCCESS. *

BY C. E. A. CARR.

For an electric road in a town or city street, or wherever pavements of a permanent character are used, the girder rail seems to be the only one suitable. The depth of the rail should be not less than 7 in., and should weigh from 70 to 90 pounds to the yard. What the exact weight of the rail should be would depend upon the frequency of the service required, and the weight of the rolling stock to be used. In a macadam or unpaved roadway, a T rail of 65 pounds to the yard is all that is necessary. While it may be better, under certain conditions, to have rails laid in concrete with a permanent pavement, my experience has been that cars rattle and jar a great deal more than when running over a road-bed of less rigidity. In all paved streets, rails should be firmly spiked on oak ties 5 in. x 7 in. x 7 feet, spaced 2 feet apart. The grade should first be properly levelled, and the whole surface covered with good coarse gravel 6 in. in depth. Fish plates or angle bars 3 feet long, with not less than 6 bolts at each rail joint, should be properly fitted and bolted. Soft copper bonds of sufficient size to carry the maximum return current from any distant part of the line to the power house, should be properly attached at each joint.

The trolley should be carried with a straight line hanger thoroughly insulated and attached to a flexible bracket or span wire.

The rolling stock should be the best obtainable, and for city traffic, mounted on single truck with wheel base not more than 7' 6".

The power house should be built near a railroad track, so that coal can be cheaply delivered, and it is very desirable that the site selected should be near a good water supply, so that condensing engines may be used. If these conditions can be had near the centre of distribution, a very great saving can be effected in the cost of copper feeders.

In Canada, where soft coal is used for fuel, the high freight and duty rates make it essential to have boilers of the highest efficiency, without much regard to their first cost. For this same reason, the boiler room should be fitted with fuel saving appliances, such as an economizer, heater, stoker, automatic damper, regulators, etc.

A certain degree of revenue is the reward of all street railways, but it is not enough that we carry our regular customers. These come to us anyway, and it is to these that we look for a guarantee of our operating expense. The profit or success of the railway lies in the margin of how many we can induce to become patrons, and thereby increase the regular revenue. One good way is to issue annually a handsomely illustrated booklet, which contains cuts of all the interesting points touched by the cars, briefly telling how to get there. A specially illuminated car for trolley parties is a profitable source of revenue. Many electric railway companies establish parks at the end of one or more of their lines, and provide amusements in the way of band concerts, etc. This brings considerable increased revenue, at a time of the day when cars would otherwise be running light. Some companies claim to have profited by this departure, while others have an adverse experience.

The selection of employees has more to do with the success of an electric railway than anything else. The idea that anyone can run a street car, has, in many cases, resulted in the employment of incompetent, careless and ignorant men, who, through these qualities, have brought the railway into public disfavor. Conductors, motormen, inspectors and shopmen have the power to earn or lose money; make the railway popular or odious with the public; keep claims for damages at a minimum or make them a burden, and very often their selection does not receive the care that is exercised in the purchase of ordinary supplies.

A NEW horseless fire engine has been put into commission at Boston. It weighs 17,000 pounds, and will be handled by three men So far it has not been tried at a fire, but the captain who has charge of it is confident of its successful working.

* Abstract of a paper read before the Canadian Electrical Association.

Industrial Notes.

A SAW MILL is to be erected in Wardner, near Vancouver, B.C.

C. R. CLOUGH & Co., Lennoxville, Que., are about to build a grist mill.

SMITH & MCLEOD have built a new sash and door factory at Vernon, B.C.

GEO W. UPHAM, Woodstock, N.B., is building a new saw mill at Fredericton, N.B.

J. W. COOK, photographer, Caledonia, Ont., has invented another unrefillable bottle.

THE McClary Mfg. Co., London, Ont., will, it is said, establish a branch in Montreal.

THE Globe Furniture Co., Walkerville, Ont., is exporting its products to South Africa.

THE Gas and Water Company, Sherbrooke, Que., has empowered its directors to sell out to the city.

THE Queen City Oil Co. has made Brockville, Ont., one of its chief distributing points in Ontario.

R. SMITH & Co., Orillia, Ont., are putting a fifty-horse power engine and boiler in their stave mill.

A COUNTY bridge is to be built over the Nottawasaga river, on the town line between Sunnidale and Essa.

THE Toronto Aqueduct Power Company's bill has been killed for the session by the Railway Committee.

THE Macgregor-Gourlay Co., Galt, Ont., has had a Grand Trunk Railway siding put into their premises.

THE Malleable Iron Works, Toronto Junction, have closed down for an indefinite period, for stock taking.

THE Carleton Place, Ont., sawmills have closed down finally, as the supply of lumber has been exhausted.

WORK is proceeding on two bridges on the Trent and Table Rivers, on the Nanaimo-Comox road, B.C.

THE Hamilton Blast Furnace Co., Ltd., Hamilton, Ont,, recently sold 800 tons of pig iron to a Montreal firm.

A. L. CASSON, of the Northwest Fixture Company, Seattle, Wash., proposes to build water works at Slocan, B.C.

LUKE MADIGAN, contractor, of Forest, Ont., has secured the contract for the $100,000 breakwater at Goderich, Ont.

THE Dominion Government has purchased a Sawyer-Massey road machine for use at the Ottawa experimental farm.

THE Nova Scotia Lumber Company has decided to rebuild its mill at Sherbrooke, N.S., recently destroyed by fire.

THE Lake of the Woods Milling Company will this year build elevators with a capacity of 200,000 bushels, in Manitoba.

NELSON, B.C., has bought the plant of the Consumers' Water Works Co. for $5,000. Possession to date from May 1st.

CHARLES C. HEARLE, Montreal, and John H. Bell, of New York, have formed a partnership for manufacturing boiler cleaners in Montreal.

GEO. MONTGOMERY is building at Dalhousie, N.B., a mill equipped with rotary, four shingle machines, planer and matcher and other machinery.

TALLMAN & SON, proprietors of the Beamsville Pressed Brick Co., have assigned to W. G. E. Boyd, Hamilton, Ont., for the benefit of creditors.

F. F. BUSTEED has prepared estimates for water works and electric light plant for the town of Fort William, calling for an expenditure of $48,000.

THE Renfrew town council has retained Willis Chipman, C.E., Toronto, as engineer for putting in a system of water-works and sewerage..

A. ROBB & SONS have purchased the Mumford Machine Works, at Hantsport, N.S., and will remove the machinery, etc., to Amherst, Nova Scotia.

IT is reported that the Gould Coupler Company, Buffalo, N.Y., will erect a plant at Brantford, Ont., to manufacture its devices for the Canadian trade.

A DAM on Ponhook Lake, above Windsor, N.S., broke recently and swept down a quantity of timber, damaging dams and bridges to the amount of $100,000.

GANONG BROS., manufacturing confectioners, St Stephen, N.B., have ordered a 100-horse-power Monarch Economic boiler from the Robb Engineering Company, Amherst, N.S.

A TWENTY-FIVE years contract for the water supply of St. Lambert's, Que., has been given to T. J. Drummond, of the Montreal Pipe Foundry Works, to be completed by Nov. 1st.

J. LIVINGSTONE, Montreal, recently recovered $374 from the Banque du Peuple, being a balance of $1,500 which he charged for managing the business of Wm. Clendinneng & Son for three months.

ABOUT three hundred men are employed on the new works of the Bushnell Oil Co., at Sarnia, Ont. At the present rate of progress, the company will equip the plant in remarkably short time.

N. N. BENTLEY, Five Islands, N.S., has purchased Hill & French's lumber property at Ship Harbor. The Ship Harbor mills, which were burnt down a year ago, will not be rebuilt.

THE Nelson *Miner* says that a powder mill is to be established at Kaslo, B.C., as T. J Watter and Raymond Meyer have decided to erect a plant that will have a capacity of 50,000 pounds a month.

C. & E. MILLER, exporters of West Australian hardwoods, have offered to supply blocks for paving 10 chains of street, in Toronto, free of charge, in order to demonstrate the suitability of this material for street paving.

THE National Convention of Master Plumbers of Canada was held in Toronto, July 1st, 2nd and 3rd Pressure on our columns prevents more extended reference this month, but we hope to give our readers an account of the meeting in our next issue.

THE Universal Patent Developing Company, Limited, applies for a Dominion charter to deal in patent rights. Capital, $20,000 The incorporators are: L. H. Henault, A. S. Delisle, M. E. Lymburner, G. N. Ducharme, Ste. Cunegonde; J. Adam, Montreal.

LUNENBURG Foundry Company, Limited, applies for a Nova Scotia charter to manufacture stoves and machinery Capital, $20,000. The incorporators are J. D. Sperry, Petite Riviere; Joseph Creighton, G. E. Sollows, W. L. Romkey and A. K. MacLean, Lunenburg, N.S.

THE Hamilton Bridge Co. has been awarded the contract for constructing bridges required in connection with the widening of the Queen street subway, Toronto, at $10,464 for a bridge to carry Grand Trunk Railway tracks, and $6,990 for carrying the Canadian Pacific tracks.

R. H. SMITH & Co., saw manufacturers, St. Catharines, Ont., are building an addition to their works in the shape of a malleable iron foundry for the manufacture of iron bedsteads. This will be the second firm making iron bedsteads in St. Catharines. The new foundry is to be in operation this month.

THE city council of St. Hyacinthe, Que., has appropriated $40,000 for the improvement of the waterworks. A new pumping station is to be built nearly a mile above the present one and beyond the city limits, and a high-duty pump, with a capacity of 2,000,000 gals. per day, will be put in. A filtering system will be adopted.

THE Government has decided to allow only 900 cu. feet of water per second to be drawn from the old Welland Canal; nearly half will be used by the company which is to supply power in Hamilton, Ont. The carbide factory and other manufacturers at Thorold, Merritton and St. Catharines have applied for the whole of the rest of the available supply.

THE arbitrators in the matter of the expropriation of the plant of the waterworks company by the town of Cornwall, have made a unanimous award placing the value of the plant and system at $78,620, which, with the ten per cent. allowed by law, brings the expropriating price up to $86,491.73. The cost of the arbitration will be about eight thousand dollars.

THE Dominion Elevator Company asks for incorporation with headquarters at Winnipeg. The capital stock of the company will be $200,000. Applicants are as follows: R. P. Roblin, G. Leary, J. Harris, D. J. Harris, D. G. McBean, R. Muir, F. Phillips, W. W. McMillan, A. McBean, S. A. McGaw, Winnipeg, grain merchants, and H. S. Patterson, Portage la Prairie.

SALARIES in the Toronto City Engineer's Department have been reduced from $24,000 to $20,000. The salary list of the department in 1890, exclusive of the surveying and plumbing departments, totalled $41,932.22, which included $4,338.76 for the waterworks branch, work which is now all done in the department. Since then the reductions have gradually reached the figures named.

ALEXANDER FORD, an employee of the Bertram Engine Works, Toronto, had a narrow escape from death recently. An immense plate of steel was being hoisted by a derrick, when the chain broke,

and the sheet of metal fell straight downwards, cutting the flesh from the upper muscles at the front of Ford's legs and severely crushing his toes. Had he been an inch farther forward when the mishap occurred his skull would have been crushed in.

THE Halifax, N.S., *Chronicle* says that a new industry is soon to be started in Halifax county. Nearly two months ago an English syndicate sent an agent to Nova Scotia for the purpose of searching for a suitable material for the manufacture of terra cotta, and as the result of his research it is understood he has been instructed to purchase some property in Halifax county, build a factory and manufacture terra cotta. The output of the factory will be sold both in the United States and Canada.

THE statement presented at the meeting of the creditors of Paxton, Tate & Co., Port Perry, Ont., who have assigned to H. Barber, Toronto, showed liabilities of $47,018.69, and assets of $44,117.69, leaving a nominal deficiency of $2,901. There are over 100 creditors, in Toronto, Montreal, Hamilton, Galt and Port Perry principally. Most of the Port Perry creditors are for small amounts. The largest creditors are William McGill, of Port Perry, $17,200; Hon. John Dryden, Brooklin, $10.750; the Ontario Bank, $6,900, and the Western Bank, $3,735.03 The banks are secured. The direct liabilities are $37,746.04, the preferred $1,105.59, and the secured $8,169.06. In the statement of liabilities the principal creditors are as follows:—Polson Iron Works, Toronto, $492; Plews & Scott, Toronto, $225; James Holman, Toronto, $102; Hamilton Blast Furnace Co., Hamilton, $264.85; H. E. Plant, Montreal, $500; Frothingham & Workman, Montreal, $251.08; James Hutton & Co., $181.65; Mrs. E. Paxton, Whitby, $1,600; Dickson & Co., Peterboro', $218.64; Ottawa Saw Works, Ottawa, $141.45; Isaac Clemence, Seagrave, $100. The statement of assets is:—Stock, unencumbered, $1,150.75; encumbered, $34,101 96. Realty, land connected with and surrounding foundry, comprising about eight acres, $700; dwelling-house, occupied by George McLean, $400; foundry buildings and outsheds, $5.500, all valued at $6,600; dwelling-house and one acre, occupied by G. H. Dryden, $3,500, less mortgage of $1,545; bills receivable, $67.50; accounts, book debts, $242.48; total assets, $44,117.69. In the preferred claims the principal amounts are for taxes, 1896, $150.27; George McLean, $175; James Reid, $150; L. N. Walling, $130.26, these latter for wages. The secured liabilities are:—The Ontario Bank, $6,900, secured by first mortgage on land connected with foundry, together with all buildings, machinery tools and material on and about the premises; also dwelling-house occupied by George McLean; the Western Bank, $3,735.03, secured by customers' paper valued at about $4,500, and also a life policy in the Mutual Reserve for $10,000; Mrs. Mary Hodgson, $1,019.06, secured by chattel mortgage on house furniture and second mortgage on foundry, machinery, tools, etc.; Goldie & McCulloch, $250, secured by lien on engine. On the indirect liabilities Hon. John Dryden, of Brooklin, is a creditor for endorsement on paper held by the Ontario Bank as additional security for $6,900.

Electric Flashes.

THE Montreal Park and Island Railway is now running cars to the Lachine wharf.

THE Watford, Ont., electric light company has recently installed a new plant.

WELLAND, ONT., is putting in an electrical fire alarm system A. Anderson, Toronto, has the contract.

H. SURTEES, son of the Ottawa city engineer, has been engaged as chief electrician of the Quebec Electric Street Railway.

THE Cornwall, Ont., Electric Street Railway has not been running a year, and already shows a profit of about five per cent.

PLANS are under consideration to extend the proposed Hamilton, Chedoke and Ancaster Electric Railway to Brantford, Ont.

STEPHEN SMITH, Toronto, has lost the use of his leg owing to the decay of the flesh, which had been exposed to X-ray photography.

THE Montreal Belt Line Railway Company intends to extend its line through Bout de l'Isle to Berthier. J. P. Mullarkey is managing director.

THE town council of Owen Sound has passed a resolution favoring the establishment of a municipal lighting plant, at a cost of about $27,000.

THE Carleton Place, Ont., council has concluded a bargain with the Bell Telephone Company to establish a general fire alarm system for the town.

THE Peterboro Electric Light and Power Co. is building a new central station this summer at which there will be about 1,000 horse-power (water) at their disposal.

THE Dundas, Ont., Light and Power Company has offered to furnish the town of Dundas with 25 street lights of 1,600 candle power for 300 nights a year, at $61.25 each.

THE St. Thomas street railway is to be converted into an electric system, says the Aylmer *Sun*. Col. Stacey, owner of the present road and J. H. Still, are interested in the undertaking.

THE Cornwall Electric Railway is now in good running, with six or eight motor cars The company is now considering the question of extending its system to some neighboring villages.

THE Minister of Public Works, Hon. J. I. Tarte, has prepared plans for extending the electric plant in the Parliament Buildings at Ottawa to supply light and also power for pumping.

THE Chambly electric power works are making rapid progress. Some 500 men are employed in this enterprise, and Peter Lyall, the contractor, hopes to have the dam finished this fall.

SADLER & HAWORTH, belting manufacturers, Montreal and Toronto, have just furnished the Hull and Aylmer Electric Railroad with two double leather main driving belts one hundred and thirty feet long and thirty-six inches wide.

THE Robb Engineering Co. are building two 300 horse-power tandem compound engines, one for the Halifax Electric Tramway Co., and the other for the St. John Railway Co. This makes five of these engines sold to the Halifax company.

GANANOQUE, ONT., has sixteen arc and eight incandescent lights, costing $1,216 a year, or $70 for each arc and $12 for each incandescent. Under a new five years' contract there will be twenty-one arcs for $1,200, and nine incandescents for $80; total, $1,280.

THE Stevens Manufacturing Co., London, Ont., have recently gone into the manufacture of dynamos, motors, transformers, switches, etc. They are the sole manufacturers in Canada under the Easton patents, and are already doing a large trade throughout Ontario.

IT is estimated that 4,000 16-candle power lamps will be required to light the new Toronto municipal buildings. The city engineer, Mr. Keating, makes an estimate of $45,000 to instal the necessary plant at the waterworks pumping station, and $5,000 a year for maintenance.

ARRANGEMENTS are being made by which Her Majesty Queen Victoria will start the electric works of the Lachine Hydraulic and Land Company at Lachine Rapids, Que. This will be done by means of the Atlantic cable, Her Majesty simply touching the electric button at Windsor Castle.

J. A. BAILEY and A. Lane, of Sandusky, O., were in Hamilton, Ont., recently, in the interests of the Partridge Carbon Company which is looking for a location for a Canadian branch of its factory. The company's specialty is an electric light carbon, which they claim is superior to those now in use.

THE Lachine Rapids Hydraulic & Land Company are now in shape for supplying power and light to Montreal, having practically inaugurated their service on Jubilee Day. They are supplying power, at $40 to $70 per h.p. per year, and incandescent lighting at from one-half cent per hour up, by meter.

IN the item in last issue referring to the installation of an electric light at Perrin's biscuit factory, London, Ont., it was stated that the whole installation was made by the Rogers Electric Co. We are informed that the plant was supplied by the Electrical Construction Co., of London, the wiring only being done by the Rogers Electric Company.

THE Montreal Street Railway Company will, it is said, adopt a new style of trolley pole. The present ones, composed of round wrought-iron piping, are to be gradually removed and replaced by small towers of angle steel riveted together. It is expected that being openwork they will more easily resist the storms of the winter, as the wind can blow through their interstices.

THE news that the Queen has approved the formation of a new volunteer corps in England, to be called "The Electrical Engineers, Royal Engineers (Volunteers)," will be pleasing to all of our readers. The idea of forming such a body of electrical engineers originated from Dr. John Hopkinson during the early months of 1896, when the Venezuelan dispute was before the country.

THE directors of the British Columbia Electric Railways, Ltd., which has taken over the business and systems of the electric railways of Victoria city, Vancouver and Westminster, are: F. S. Barnard, Horne Payne, R. M. H. Payne, A. C. Mitchell-Innes, R. N. Laurie, G. P. Norton, and R. S. Sperling. Qualification, £500; remuneration, £1,000 per annum and a share in profits.

THE Montreal Street Railway Co. has erected two miniature Eiffel towers of angle steel a hundred and sixty-five feet high They are nineteen feet square at the base, and fifteen inches square at the top. They rest on a foundation of concrete twelve feet deep These towers will support a cable across the Lachine Canal into Point St. Charles, to supply power to the company's line.

FIVE companies tendered for the construction of the Chatham, Ont., civic electric lighting plant. They were the Stephenson Company, of London; John Abell, Toronto; the Thompson Electric Company, Hamilton; the Royal Electric Company, Montreal, and the Harris Electric Company, Detroit, U.S.A. A number of them tender only for the electrical apparatus, wiring, etc., while others make their tender cover everything required.

AT a recent special meeting of the town council of Niagara Falls, Ont, a by-law was introduced giving the electric-car company holding the present charter for the horse-car line a 20-year charter, with the privilege of running over the same route, with a few extensions, providing the company put in motive power other than horses or steam. The company must act within thirty days of the passing of the by-law and complete the line within sixty days.

NEARLY 400 people registered their attendance at the convention of the National Electric Light Association at Niagara Falls, N. Y. June 8th—10th. Details in next issue. Among whom were noted the following: F. C. Armstrong, Toronto; T. A. Badger, jr., Quebec; E. B. Biggar (CANADIAN ENGINEER); F. A. Bowman, New Glasgow, N.S.; John Carroll, Montreal; Prof. C. A. Carus-Wilson, Montreal; E. E. Cary, St. Catharines; E. T. Freeman, Halifax, N.S.; W. A. Johnson, Toronto; J. A. Kammerer, Toronto; R. S. Kelsch, Montreal; John Langton, Toronto; Frank LeBlond, Niagara Falls, Ont.; E. D. McCormack, Toronto; Charles Morton, Montreal; John Murphy Ottawa; Frederic Nicholls, Geo. A. Powell, St. Catharines, Ont.; J. F. Rothsay, Niagara Falls, Ont.; A. E. Smaill, Montreal; W. McLea Walbank, Montreal; Geo. W. Watts, Toronto.

THE West Kootenay Power and Light Company, Limited, which was recently organized for the purpose of developing the magnificent water power available at the Falls of the Kootenay, ten miles from Nelson, B.C., has just closed a contract for the hydraulic and electrical machinery, to develop 2,000 horse-power, immediately, the ultimate scope of the undertaking being the utilization of the full power of the river at this point, estimated at from 8,000 to 10,000 horse-power. At the head of the company is Sir Charles Ross, Bart., who is largely interested in mining properties, and with him are associated C. R Hosmer, Frank Paul, and other influential and well-known capitalists. The services of Robert Jamieson, formerly engineer in charge of the Lillooet, Fraser River and Cariboo Gold Fields Co., Limited, have been secured to supervise the entire undertaking, and his wide experience in mining engineering work of all kinds, will insure the most efficient working out of all the detail appliances necessary to apply the electric power in the most satisfactory manner for mining work. Some interesting details as to the electrical features of the scheme have been made known. The apparatus will be of the three-phase type manufactured by the General Electric Company, Limited, and the generators of the revolving field type, similar to those now being installed in the large power plant of the Lachine Rapids Hydraulic and Land Company at Montreal. The initial generating plant will consist of two machines, having a capacity of 1,000 horse-power each, from which the current will pass through step-up transformers, raising it to 20,000 volts, the highest pressure as yet used on any electrical transmission line. At this high pressure, the energy will be carried to a sub-station at Rossland, a distance of thirty miles, where it will be reduced to a pressure of 2,000 volts for transmission to the motors used in connection with the different mining enterprises. The electric power will be used for operating tramways, hoists, pumps, ventilators, stamp mills, drills, etc., and will be sold at a price which, in comparison with the present high cost of power generated from coal, means a greatly reduced expenditure in this direction by the different mining companies The machinery is now in course of construction, and the plant is to be in full operation early in the Fall.

A SAFETY VALVE PROBLEM.

Editor CANADIAN ENGINEER.

SIR,—Kindly answer this safety-valve question in the July issue of your valuable paper: What is the weight required on the end of the lever, not considering the weight of the valve stem or lever, when the length of the lever is 36 inches, the diameter of valve is 3 inches, the fulcrum is 3 inches, and the steam pressure 125 pounds?

THREE ENGINEERS.

Under the conditions stated, viz., lever, 36 ins; diameter of valve, 3 inches; fulcrum, 3 inches; pressure, 125 lbs., the weight required on the lever is 76.542 lbs.—[EDITOR.

AT a public meeting held recently in Rat Portage, Ont., it was resolved that water works were at once necessary for the health of the town. T. R. Deacon is town engineer.

Railway Matters.

RICHARD WOOD has been appointed receiver of the St. Catharines and Niagara Central Railway

THE C.P.R. has arranged for the construction of 1,000 new freight cars at their various shops

PEMBROKE, ONT., has passed a by-law to grant a bonus of $20,000 to the Pembroke Southern Railway.

QUITE a number of Canadian Pacific workmen have been sent from Toronto Junction to Perth, Ont., to assist in the construction of 200 new freight cars.

THE C.P.R. have received a number of new refrigerator cars from their Perth workshops. Five of them have been sent to Weehawken, N.J., to load butter for Australia

THE Richelieu & Ontario Navigation Co has issued a very neat pamphlet showing to its friends the beauties and attractions of the Ontario waterways. Some interesting chapters are devoted to the lovely spots between Montreal, Toronto and Hamilton.

IT is reported that General Manager C. M. Hays, of the Grand Trunk Railway, has issued an order to the effect that section foremen must dispense with the services of relatives working under them, and that relatives must not in future be employed by them.

A. FACKNEY has contracted for the erection of car-houses, etc., for the Quebec District Railway Company on St. John, d'Aiguillon, Racine and Richelieu streets, Quebec, the building to be 176 by 116 feet, two stories, in brick and stone with mansard roof, at a cost of $25,000.

ON June 1st the Dominion Government officials stopped the running of trains on the Baie des Chaleurs Railway, which has been operated as a branch of the Intercolonial since January last, and the road was handed over to the representatives of the Atlantic & Lake Superior Railway Company.

THE Railway Y.M.C.A., which was opened a short time ago in roomy quarters, Front street and Spadina avenue, Toronto, by General Manager C. M. Hays and a number of distinguished men and philanthropists, is doing a splendid work. There is quite a good library in the association rooms.

D. F. BURK, Port Arthur, Ont., has secured an injunction restraining the provisional directorate of the Ontario Rainy River Railway receiving a first payment of $7,000 in the sale of the Ontario Rainy River Railway. The purchasers are Wm Mackenzie, president of the Toronto Street Railway Company, and his brother, R Mackenzie

THE C.P.R. has let the contract for the construction of the Slocan valley branch of the Columbia and Kootenay system McVey & Poupore will do the grading from Slocan Crossing to within sixteen miles of Slocan. The rest of the work will be done by McLean Brothers, of Nelson. About 1,000 men will be employed this summer establishing the necessary grade, constructing bridges and putting down the rails.

W. J HANLY, Toronto, will have charge of construction on the Crow's Nest Pass Railway when it is begun. Mr. Hanly has done a good deal of work for the Canadian Pacific, and was, in fact, the first superintendent of the Canadian Pacific before the formation of the present company, and built the Pembroke branch, and also the Kingston and Pembroke. On the main line, Mr Hanly built the section between Rat Portage and Selkirk, Man., a distance of 150 miles, and likewise from Port Moody to Griffin Lake, 350 miles.

JOSEPH HOBSON, chief engineer of the Grand Trunk Railway System, having been assigned the entire charge of the construction of the new Victoria bridge, it has been decided that, to enable him to devote his personal attention to this and other important new works of the company, taking effect July 1st, the immediate supervision of the maintenance of track, buildings, water stations and wooden bridges will be placed under the jurisdiction of the superintendents of the respective divisions, who will report to and receive their instructions from the general superintendent, F. H McGuigan The chief engineer will continue in charge of the St. Clair tunnel, all iron bridges, masonry and signals and interlocking. He will also have the direction and supervision of all contract work, the preparation of plans, specifications and estimates for new work, and the custody of original maps and profiles of the roads comprising the system.

Mining Matters.

M. Beatty & Sons, manufacturers of contractors' plant and mining machinery, Welland, Ont., have appointed E. Leonard & Sons their agents in Montreal.

The following are the duties upon ore brought down by the Dominion Government: (a) On nickel contained in matte or in the ore, or in any crude or partially manufactured state, and upon copper contained in any matte or ore, which also contains nickel, when exported from Canada, upon such nickel an export duty not exceeding 10c. per pound, and upon such copper an export duty not exceeding two cents per pound. (b) On ores which contain copper or any metal other than nickel or lead, when exported from Canada, an export duty not exceeding 15 per cent. on the value of the said ores. (c) On lead ores, and on lead and silver ores, when exported from Canada to a country which imposes an import duty on lead in bar or in the form of pig lead in excess of the import duty on lead contained in lead ores, or in lead and silver ores, an export duty on the lead containing the ores so exported from Canada to an amount per pound equivalent to such excess.

A discovery of black granite is said to have been made at Welsford, N.B. The property has been acquired by a Bridgewater, Nova Scotia, firm, and they will commence the erection of polishing works.

The successful operation of the new calcining and refining furnaces at the Nelson, B.C., copper mines, has been a matter of general congratulation, and the fineness of the copper produced has been steadily improved. The grade now produced is 98 and 99 per cent. copper, silver and gold, and as much as fifteen tons have been taken from the refining furnace from a single charge.

This season there will be four members of the Canadian Geological Survey at work in Nova Scotia. Dr. Ellis, Mr. Fletcher and Dr. Ami will visit the coal measures and complete surveys that have been going on for some time. Mr. Fairbault will resume his study of the gold-bearing rocks along the Atlantic coasts of that province.

The Hawk Bay mine in western Ontario is now equipped with a fine plant, the machinery consisting of two 35 h.p. boilers, a three drill air compressor, three Rand drills, a 17 x 10 double cylinder hoisting engine, and a single cylinder hoisting engine.

A new dredge is to be put in place at Big Bar, on the Fraser River, where, H. O. Bowe says, a bucketful of gravel yielded $2 in gold.

Wm. Ogilvie, D.L.S, gives some startling information about the richness of the gold-bearing gravel in the Klondike region on the Yukon. Placer mining is being carried on in Bonanza Creek, an affluent of the Klondike, and the workings must be exceptionally rich, for three men worked out $75 in four hours, and a $12 nugget has also been found, showing that there is coarse gold and plenty of it. It is claimed that from $100 to $500 a day can be made off the ground that has been prospected. One man washed out a single pan of dirt on one of the claims and found $14 25 in it. The average on that claim, it is reported, is $5 to $7 per pan, with 5 feet of pay dirt and the width yet undetermined; but it is known to be at least 30 feet, so that, figuring at nine to ten pans to the cubic foot, on a length of 500 feet, the result would be nearly $4,000,000, at $5 per pan. Another claim has been prospected to such an extent that it is known there is about 5 feet of pay dirt, averaging $2 per pan, and of a width of not less than 30 feet.

Marine News.

The Dominion Atlantic Railway Co. is building a wharf at Yarmouth, N.S.

An attempt was made to burn the steamer "Lakeside," at St. Catharines, Ont., recently.

The Ontario Government has granted two leases for the ferry business between Kingston and the islands.

The Rondeau and Cleveland Steamship Company, Limited, has applied for incorporation. Chief place of business, Chatham, Ont.; capital, $20,000.

The Richelieu and Ontario Navigation Co.'s steamer "Corsican," which was practically rebuilt last winter, is now one of the finest boats on the lake and river route.

The contract of Wm. Davis & Sons at Cardinal, on the St. Lawrence Canal, will involve the making of a cut half a mile long, 60 feet deep and about 300 feet wide.

The contract for building the wharf at Pugwash, N.S., for which $10,000 were placed in the estimates in the last session of Parliament, has been awarded to McDonald & Moffat, North Sydney, C.B.

The Canadian Pacific Railway Company will add to its fleet on the Columbia by building an express boat for carrying passengers, mail and express. The keel of the new boat was recently laid at Nakusp. When completed, it is expected that the boat will be the fastest craft in any of the inland waters of the North-West, and it is expected to make the time from Trail to Arrowhead in 24 hours, equal to 19 miles an hour. The boat will be christened "The Flyer."

After being bitterly fought, step by step, through the courts for nearly a score of years, a decision has been handed down in the United States Supreme Court, in the case of the owners of the barges "Eldorado," "George W. Wesley" and "Bay City," against the owners of the steamer "J. B. Donaldson." The court held that when a steamer is compelled to desert her tow in a storm for self preservation she cannot be held liable for any general average loss sustained by the tow.

Personal.

J. F. Millar, of Morrisburg, Ont., recently visited Japan as agent for the Leonard & Ellis Oil Company.

Joseph McNeil, an employee of the Nova Scotia Steel Co. at Ferrona, N.S., was killed recently by falling from a moving train.

C. H. Rust, assistant city engineer, Toronto, has been appointed a member of the council of the Canadian Society of Civil Engineers.

The fly wheel of the engine in the St. John, N.B., street railway power-house burst recently, seriously injuring Chas. Sullivan, who was in charge.

Elisha Stewart, O.L.S., Collingwood, Ont., has been appointed by the Ontario Government as chief of the Bureau of Mines Department, to be established at Rat Portage, Ont.

Wm. Davidson, Sherbrooke, Que., who recently graduated with high honors from Columbia College, New York, has been sent to Japan by the Rand Drill Company to erect a large mining plant.

Sydney M. Johnson, B.A., Sc., P.L.S., and J. E. McAllister, B.A., Sc., have opened an office in Trail, B.C., where as Johnson & McAllister they do business as surveyors, assayers and mining engineers.

Alexander R. Goldie, of Goldie & McCulloch, Galt, Ont., was recently married to Miss Nora Gibson, daughter of the late James Gibson, at the residence of the bride's mother, "Spring Valley Farm," Berlin, Ont.

D. J. Waterous, of the Waterous Engine Works Company, Brantford, Ont., was polishing the chain of his bicycle recently on an emery wheel. While working, the chain in some manner was caught and jerked violently, and winding round his arm tore the coat sleeve off and inflicted painful bruises and cuts all the way up his arm.

R. O. King, B.A.Sc., Toronto, who graduated from McGill University with the British Association Gold Medal in 1895, and whose portrait appeared in The Canadian Engineer at the time, has just been appointed to the William Whitney Fellowship, at Harvard University, where Mr. King has been taking a course in the graduate school. Mr. King was born at Port Hope, Ont., 23 years ago, and received his earliest education at Georgetown, Ont.

Whilst superintending the construction of machinery at Montmorency Falls, not long ago, Omer Carrier, of the firm of Carrier, Laine & Co., Levis, Que., accidentally touched a live wire. He was knocked down, but rising again he said to those around him, "Oh, it is nothing." He sank to the ground again, and all efforts to revive him were fruitless. Mr. Carrier, who was 27 years of age, and leaves a widow and two children, is much regretted by a large circle of friends

J. R. Roy, C.E., formerly of Montreal, who is in the Public Works Department of Canada, has recently been appointed to fill the important position of resident engineer in the Province of British Columbia, where he will have the full charge of all the work of the department in that province. The chief provincial office of the department has recently been moved from Victoria to New Westminster, from whence Mr. Roy will leave early in July for a tour of inspection of the other offices of the department in the province. A very important part of Mr. Roy's work has been the establishing, at different points along the Fraser River, of gauges to record its rise and fall. The state of the river will be telegraphed to points which have before now suffered by inundations, and farmers will in future have due warning.

The 29th annual convention of the American Society of Civil Engineers opened in Quebec, July 1st.

The Canadian Engineer

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C. E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAPTER II.

TRAIN RESISTANCES AND THEIR COST.

ART. 6.—TRAIN RESISTANCES.—(*Continued*).

(C.) CURVE RESISTANCES.

In America a curve is designated by the number of degrees which a hundred foot chord subtends at the centre of the circle, thus a 1° curve subtends 1°, etc. The radius of a 1° curve=5730 feet, and the radius of a

$D°$ curve is (approx.)$=\frac{5730}{D}$ feet.

The centrifugal force of a train passing around a curve at v feet per second $= C = \frac{We^2}{gr}$ ..... (6)

If we change v into V (miles per hour) and r into D (degree of curve) we will get $C = \frac{W}{32.2} \times \frac{V^2(1.467)^2}{1} \times \frac{D}{5730} = \frac{WV^2D}{85666}$ ..... (7)

Now, in order to counterbalance this force, the outer rails, on curves, are elevated sufficiently above the inner ones (super-elevation) to make the resultant of gravity and centrifugal force to pass midway between the rails and at right angles to the track, and the floor of the car will then be parallel to the track (see Fig. 3). It is evident from the figure that by similar triangles

$$\frac{\text{Super-elevation}}{\text{Gauge}} = \frac{\text{Centrifugal Force}}{\text{Weight}} \text{ or}$$

$$\text{Elevation} = E = G \times \frac{C}{W} = \frac{59V^2D}{85666} \text{ from (7)} \quad \ldots\ldots (8)$$

by which it will be seen that the required elevation varies directly with the degree of curve and with the square of the velocity.

For a 1° curve, $E = \frac{59}{85666} V^2 = .00069\ V^2$ ..... (9)

TABLE VII.

TABLE OF SUPER-ELEVATION OF OUTER RAIL PER DEGREE, FOR DIFFERENT VELOCITIES.

V (miles per hour)	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100
E (inches)	.02	.07	.15	.28	.43	.62	.84	1.10	1.40	1.72	2.48	3.36	4.40	5.57	6.88

It is evident, however, that only at that particular speed for which the outer rail is elevated will the car body be normal to the track. At slower speeds the inner springs will compress and outer ones extend somewhat, while for higher speeds the reverse will be the case. The custom, on general traffic roads, is to elevate for medium passenger speeds of say 30 miles per hour, which is slightly over one-half inch per degree, while on high speed passenger tracks of roads having only light curves, particularly, elevations of as much as one inch per degree are common.

It may be assumed that a safe maximum riding speed will exist when the car body becomes level. Wellington's assumption is that the weight of a passenger-car will compress its springs six inches, and that the distance of the centre of gravity of the car body above the springs is equal to the distance of the springs apart giving equal turning couples. The total centrifugal force necessary for this action will be approximated.

$$C = \frac{WV_1^2D}{85666} = \left(\frac{E}{6} \times \frac{W}{2}\right) + \left(\frac{WV^2D}{85666}\right) = \frac{59V^2DW}{12 \times 85666} + \frac{WV^2D}{85666}$$

or, eliminating, $V_1^2 = \left(\frac{59}{12} + 1\right) V^2 = \frac{71}{12} V^2$

$\therefore V_1 = 2.43V$ ..... (10).

(where V_1 = speed to bring car body level.)

(V = speed for which track is elevated.)

This speed is, evidently, independent of the curvature.

The speed at which trains, running on tracks properly elevated, will overturn, is very high, and not of sufficient interest to calculate, and will depend on the amount of compression possible in the springs before the car body comes down on the buffers, and upon the amount of elevation per degree of curve given to the track.

Those roads which have sharp curves will always run at moderate speeds around them; the sharper the curve the less the speed. This fact and practical ballasting difficulties have limited the total super-elevation to about six or eight inches, which corresponds to a curve of 8° to 12°, depending on the speeds expected, on curves of greater sharpness the lessened speeds will require less elevation per degree.

The position which a short rigid truck assumes in passing around a curve is as in Fig. 4: the front outer wheel flange against the rail head, and the rear wheels radial to the curve and midway between the rails, unless

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

the curve is so sharp or the truck so long as to render this impossible, when the rear inner wheel flange will also jam against the rail. This, however, will not happen with a 5-foot American truck on any ordinary curve. Wheels are still made with a modified coning (see chapter on track), but this is intended only to provide for future wear, as it is proven that it does not aid in passing around curves by the whole truck moving to the outside, as was formerly supposed to happen.

In passing around a curve the wheels slip in two directions, besides flange friction: (1) Longitudinal, due to the inner and outer rails being of different lengths; (2), lateral, due to a continuous sidewise movement in changing direction. This latter is confined to the front axle, as the rear one keeps radial always to the curve. The amount of these slippages are calculated, if necessary, as fol ows: (See Fig. 5)

(1) Longitudinal slippage $= \frac{\text{gauge}}{\text{radius}} \times$ distance travelled.

(2) Lateral slippage = sin. angle $a \times$ distance travelled for 5-foot American truck, sin. a = .00087, and lateral slip = .00087 d.

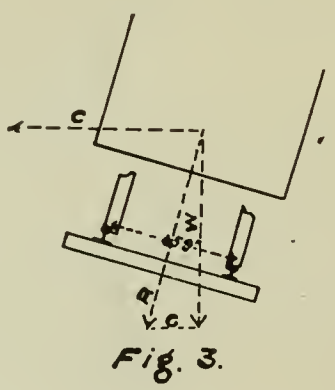


Fig. 3.

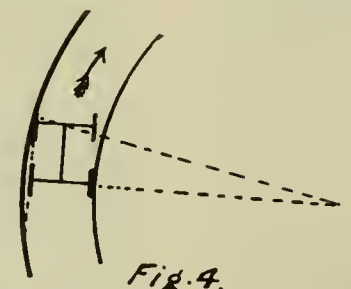


Fig. 4.

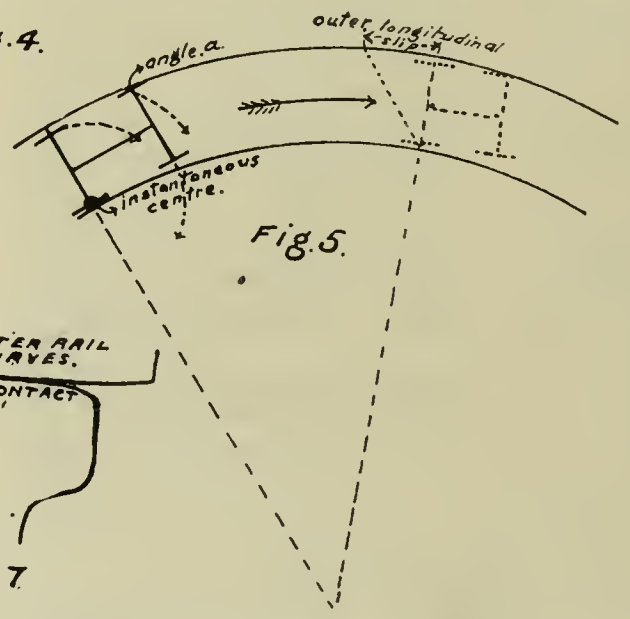


Fig. 5.

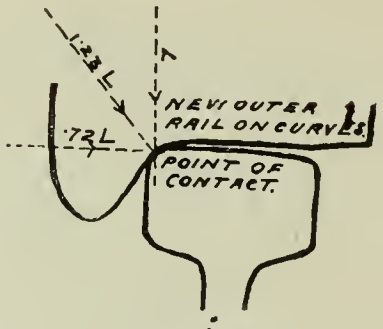


Fig. 6.

Fig. 7.

It will be seen by Fig. 5 that the truck is turning continually around the inner rear wheel as a centre, and the aggregate slippages are as follows:

(1) Rear inner wheel does not slip at all.

(2) Rear outer wheel slips longitudinally.

(3) Front inner wheel slips laterally.

(4) Front outer wheel slips laterally and longitudinally.

TABLE VIII.

	1° Curve Ft.	5° Curve. Ft.	10° Curve. Ft.	20° Curve. Ft.
Average slippage per wheel, per foot	.00073	.00363	.00730	.0145
Average velocity of slippage (in feet per second), train going at 30 miles per hour	.043	.21	.43	.86
Ditto (miles per hour)	.029	.145	.29	.54

It is noticeable that the slipping is at a very low rate, being for ordinary curves and speeds only a fraction of one mile per hour, and which ever wheel starts slipping, whether inner or outer, will continue to do so around any particular curve; but this is immaterial.

Now, the coefficient of sliding friction between steel tires and steel rails under different velocities is about as follows:

0+	miles per hour	.242
7	" "	.088
13	" "	.072
34	" "	.065
52	" "	.040

And as anything in the above table is nearly at zero-miles per hour, we can be safe in assuming a coefficient for this slippage at from .24 to .20, with a tendency to get less as the curve gets sharper (contrary to earlier notions on curve resistances.)

In addition to these slippages we have flange friction (see Fig. 6). When the rail is new the line of pressure is nearly a point; the two forces acting on the front outer wheel are the load on the wheel and a lateral horizontal force sufficient to cause the slippages to take place, which have already been mentioned. If we take the coefficient of friction at .24, then there will be a total force of .72 $\angle$. This is combined with the vertical force $\angle$ to give a resultant force 1.23 $\angle$, acting as shown in Fig. 6. This causes the radius of the outer wheel at its line of bearing to be $\frac{1}{8}$ inch to $\frac{1}{4}$ inch larger than the inner one, and a consequent slippage takes place which is constant for all curves. The amount of friction caused by this increases rapidly as the rail becomes worn and the surface of contact increases. (See Fig. 7). So that any estimate of its actual amount will be useless unless we know the exact condition of the rail head and wheel flange.

Wellington estimates it to be 1 lb. per ton for new rails, with a considerable addition as rails become worn. This will not vary with the curvature, and is to be added to the amount calculated from Table VIII., which, taking the coefficient of friction at .24, amounts to .35 lbs. per ton per degree. The results of experiments confirm the theory that the total amount varies from $\frac{1}{3}$ to $\frac{2}{3}$ lbs. per ton per degree, increasing as the condition of the rail becomes worse, and the surface of contact, for flange friction, greater. The total curve resistance does not increase quite as fast as the curvature when the rails are new, but as the rails become worn the opposite is the case; and as the rails on curves become worn more quickly the sharper the curve, it is probably safe, as an average, for ordinary use, to assume that curve resistance varies with the curvature, and equals $\frac{1}{2}$ lb. per ton per degree. Referring back to grade and level tangent resistances, we see that—

6 lbs. per ton = resistance on 12° curve.
= resistance on $\frac{3}{10}$% grade.
= level tangent resistance at low speed.

Or that a 12° curve doubles the level resistance, or that a 1° curve is equal in train resistance to a .025%g rade ; strictly, therefore, we should lessen gradients on curves by .025 for each degree of curve, to compensate for curve resistance, but this would be scarcely enough, for whenever a train is nearly stalled, curve resistances due to low speed will be much higher, and if the train is once stalled it will be hard to start again on a curve just barely compensated. For this reason it is customary to compensate for curves at a higher rate than is theoretically necessary, the usual amounts being .04 to .05 per degree of curve, depending on how valuable a few feet are, in elevation, on maximum grades.

ART. 7.—THE COST OF TRAIN RESISTANCES.

It must not be supposed that the expenses of operating a road vary with the total train resistances found according to the rules given in Art. 6. Even the fuel consumed is only affected partially by variation in train resistances; some are affected very much, as car repairs and rail wear, while others, such as maintenance, general expenses, etc., are hardly affected at all.

(*A*) *Cost of Curve Resistances.*—It is estimated that 36 per cent. of the working expenses vary with the curve resistances, and taking the cost of a train mile at 90 cents, and a continuous 12° curve for a mile = 633° curvature, = one mile of level tangent resistances; then, the cost of operating a train each way for a year around 1° of curvature $= 365 \times 2 \times \frac{90}{633} \times 36$ per cent. $= 37\frac{3}{10}$ cents, therefore, we are justified in spending $\frac{100}{5} \times 37.3$ cents = $7.46 per daily train, during construction, in eliminating each degree of curvature with money at 5 per cent., any number of trains per day, or degrees of curve in direct proportion, from which it is evident that the worst features of sharp and heavy curves are more questions of appearance, comfort and safety, than of actual cost in operating, especially as the case is always one of more or less curvature only, and not a question of curves or no curves.

With roads expecting light traffic and heavy grading, it is evident that a very great amount of curvature will be justified ; and then, too, it must be remembered, that it is the total angle of a curve and not its sharpness that counts in the total train resistances ; the only objections to sharp curves are the slightly increased danger of derailment, the necessary slackening down from very high speeds, the slight lengthening in distance, and the sentiment of the public against them.

(*B*) *The Cost of Grade Resistances.*—Grades must be viewed from two standpoints : first, as so many feet of rise and fall, up and down which the trains must be carried ; and second, as the limiting features to the maximum load which a given engine can haul at a low speed over a freight engine division. Under the first heading Wellington divides them into three classes :

(1) Those which are so light or short as to be passed over with uniform steam on and no brakes, the speed only, fluctuating. Such grades cost nothing appreciable more to operate than level grades, as the trains going each way in a day gain as much energy as they lose. These grades would be, roughly, anything less than 0.5 per cent.

(2) Those in which steam is cut off in descending, but which do not need brakes in descending nor sand in ascending. It is estimated that one foot of rise and fall, per daily train per year on this class of grade, costs :

Eighty-four cents, if a minor grade, which equals $16.80 capitalized; $1.67, if a maximum grade, which equals $33.40 capitalized. These may be taken roughly as grades between 0.5 per cent. and 0.8 per cent.

(3) Those on which brakes are needed in descending and sand used in ascending. These are estimated to cost per daily train per year, per foot of rise and fall, $3.50, which equals $70, capitalized at 5 per cent. These may be taken as any grades over 0.8 per cent., unless of very short length. By multiplying the above sums ($16.80, $33.40, or $70) by the number of daily trains expected, we can arrive at the total expenditure justifiable to save each foot of rise and fall.

TABLE IX.

(See Wellington, page 544, for larger table.)

NET TRAIN LOADS OF VARIOUS ENGINES ON VARIOUS GRADES TAKING 25 PER CENT. AS THE RATIO OF ADHESION.

Grade.	Resistance per ton (in lbs.)	Passenger.		Mogul and 10-wheel			Consolidation.			Mastodon.
		Total Wt.		Total Wt.			Total Wt.			Total Wt.
		52 tons.	58 tons.	60 tons	64 tons.	67 tons.	70 tons.	75 tons.	80 tons.	87 tons.
		Weight on drivers.		Weight on drivers.			Weight on drivers.			Weight on drivers.
		20 tons.	24 tons.	28 tons.	32 tons.	36 tons.	40 tons.	44 tons.	48 tons.	52 tons.
Level	8	1,198	1,442	1,690	1,935	2,183	2,430	2,675	2,920	3,163 tons
1/10 per cent.	10	948	1,142	1,340	1,536	1,733	1,930	2,125	2,320	2,513 "
3/10 "	14	662	799	940	1,079	1,219	1,359	1,496	1,634	1,770 "
1/5 "	18	504	609	718	825	933	1,041	1,147	1,253	1,357 "
1 "	28	305	371	440	507	576	644	711	777	842 "
1½ "	38	211	258	308	357	407	456	504	552	597 "
2 "	48	156	192	232	269	305	347	383	420	455 "
2½ "	58	120	149	181	212	243	275	304	334	361 "
3 "	68	95	118	146	171	195	224	249	273	295 "
4 "	88	62	78	99	118	138	157	175	193	208 "
5 "	108	41	53	70	84	100	115	129	142	151 "
10 "	208	0	0	7	13	20	26	31	35	38 "

Remember the above sums are not supposed to be precise, but to be as near as it is possible to arrive at the truth. These figures refer to the cost of grades regarded merely as so many feet of rise and fall, and are entirely independent of and distinct from the effect which the maximum grade has on the train load, which is a far more important matter. In special cases, as on the N. Y. C. and H. R. Railway, where the grades are very light, the curves are the limiting features, but usually grades limit and determine the load which a given engine can haul. The hauling capacity usually depends on the weight on the drivers, and the ratio of adhesion, although for high speeds the limits of boiler capacity or cylinder power may be reached first; for freight work, however, the former are all we need to consider. The ratio of adhesion varies from 20 per cent. on slippery rails to 25 per cent. in ordinary weather, and to 33 per cent. where sand is used, but falls at once to about 10 per cent. when the driving wheels begin to slip. For any assumed ratio of adhesion it is easy to compute the load which an engine of known weight on drivers can haul up any grade. The total load includes the engine itself, but on light maximum grades it is not usual to haul maximum loads because of the difficulty in handling long trains and making couplings strong enough to transmit a very heavy pull when combined with the severe jerks caused by the great amount of slack in link and pin couplers. The increasing use of automatic vertical plane couplers having very little slack will soon do away with this difficulty and enable longer trains to be handled with facility. Table IX. enables us to compute the increased or decreased engine mileage due to a change in maximum grades, for any given amount of traffic. For light traffic such calculations must be modified, as more trains will be run to accommodate traffic than are strictly required to carry it, and only as traffic increases so as to afford at least two or three fully-loaded freight trains per day will such calculations be rigidly true—even

then many roads estimate so many cars as a train load irrespective of the load on the car, and the adoption of a tonnage system for making up train loads will, in many cases, effect great economy.

It is noticeable that, on heavy grades, the level tangent resistance forms a very small proportion of the total resistance, and also that, for any given increment of grade, the increase per cent. of engine mileage is much less as the grades become heavier.

Decreased hauling capacity, on heavy grades, may be met in two ways, either by increased weight of engines, especially the weight on the drivers, as is evident from Table IX., or by increasing the number of trains (*i.e.*) the engine mileage.

The former is, of course, the cheaper method, but as the changes in grades that an engineer is called on to discuss are usually relatively small, it is only fair to suppose that the economy of heavy engines will have been realized in both cases; but supposing it possible to increase the weight of engines for heavier grades, only very few of the expenses of operating are increased. Wellington estimates that track maintenance, renewals and engine repairs are increased 50 per cent. as fast as the weight of the engine increases; fuel 25 per cent. and other items practically unaffected. Altogether, the operating expenses will only increase 14 per cent. as fast as the increase in weight of engines.

On the other hand, the usual necessary course on heavier grades will be to run more trains of less tonnage, with the same weight of engine, for a given traffic. This is a more expensive matter.

TABLE X.

INCREASE OF OPERATING EXPENSES WITH INCREASED ENGINE MILEAGE.

Item.	Cost of Item.	Per cent. increase.	Extra cost
Fuel, oil, and waste	8.8 %	67 %	5.9 %
Engine repairs	5.6 "	75 "	4.2 "
Switching engines	5.2 "	0 "	.0 "
Train wages	15.4 "	100 "	15.4 "
Car maintenance	12.0 "	− 10 "	− 1.2 "
Track maintenance, etc	17.5 "	100 "	17.5 "
Bridges and buildings	5.5 "	0 "	0.0 "
Station and general	30.0 "	20 "	6.0 "
Interest on extra engines	....	..	1.7 "
	100 %		49.5 %

It will be seen that, say, 50 per cent. of the operating expenses increase with an engine mileage increase, as compared with 14 per cent. in the first case. This is why the weight on drivers is being continually increased, and the strength of the track to carry it, on all roads having much traffic to handle, as being the cheaper expedient.

We are now prepared to estimate the cost of increasing the ruling gradient on an engine division (100 to 125 miles).

Taking a train mile to cost 90 cents, we have $90c. \times 365 \times 2 = \$657$, as the cost of hauling a daily train (both ways) per mile, per year. If we take this *yearly train unit*, multiply it by the number of miles in a given engine division, by the increase in the number of daily trains necessitated by the heavier grades, and then by 50 per cent. (see Table X), we will have the amount which it will probably cost per year more to operate on the heavier grades than the lighter ones. If we capitalize this sum we get the amount which, for a given traffic, it would be wise to expend to construct a road with the lighter ruling grades rather than the heavier ones. (*e.g.*) To avoid changing our ruling grades from 1.0 per cent. to 1.5 per cent. on a hundred mile division, we would be justified in expending anything less than

$$\left(\frac{1000}{504} - \frac{1000}{711}\right) \times \$657 \times 100 \times 50\% \times \frac{100}{5} = \$328,500$$

for every 1,000 tons of gross freight per day, taking a seventy five ton consolidation engine as the basis of comparison, and, roughly, two trains per day in one case and one train one day and two trains next day, in the other case, or one-half train per day difference. Now this is a very modest traffic, and yet we could afford to expend $3,285 per mile more in one case than the other, and it is really very much more than it appears, for two reasons:

(1) Because ruling grades in most cases will probably not extend over more than one half of the road as a maximum, and we can therefore spend twice as much per mile on them, or $6,570 per mile as a minimum, on the portions to be improved.

(2) Because all this money can be used below the ballast since track, equipment, stations, etc., in fact, all other items, remain unchanged, now to show how moderate a proportion the cost of substructure is of the cost of the whole road, the following table is given:

TABLE XI.

COST OF FOUR TRACKS OF N.Y.C. AND H.R. RAILWAY PER MILE.

Grading and masonry	$22,000	= 18.9	per cent.
Bridges	3,030	" 2.6	"
Superstructure	32,500	" 27.9	"
Stations, etc.	15,400	" 13.3	"
Land and damages	15,740	" 13.6	"
Engines and cars	24,077	" 20.7	"
Engineering and incidentals	3,453	" 3.0	"
	$116,200	" 100	"

This is an extreme instance, as grading was light and equipment expensive; the items affected (1 and 2) are only 21½ per cent. of the total, and probably 25 to 40 per cent. will give a good average for ordinary single track roads. Each country traversed is suited to certain maximum gradients, and an endeavor to modify them extensively will bring very heavy additional expenses, but within narrow limits, such as a change of ruling grades by as much as $\frac{2}{10}$ or $\frac{3}{10}$ per cent., the advantages of a liberal expenditure of money to obtain the lesser grade are often overlooked and the 'penny wise" maxim adopted. Every engineer who has the decision of the ruling grade should study such figures carefully, and by as extensive surveys as possible determine what is the least ruling grade that he can get at a cost which will be justified by present or expected traffic, always, of course, considering how much money can be got at all, for no expenditure can be justified that will in any way endanger the successful completion of the road; he must consider each item of expenditure or economy, *per se*, whether it is wise or not, remembering always that it is the *difference* of gross receipts, working expenses and fixed charges that is to be thought of in determining the best general route.

Note, however, that these calculations and estimates do not hold strictly true for roads of very light traffic, because some trains must be run in any case to accommodate traffic at certain intervals, and if they are not fully loaded, then an increase of grade will not have any effect until it causes an increase in the number of trains, as a change in the rate of grade does not usually mean any increase in the total rise or fall.

In comparing two routes for costs of operation the best method is to assemble the curves and grades of different classes and take their differences, pro or con, also the difference in the number of trains per day necessary to handle the probable traffic. These differences multiplied by their proper multipliers will give a comparison of how much more valuable one route will be than the other for a given traffic, and will determine consequently how much more can be justifiably spent to construct one route rather

than the other, *other things being equal.* In such a comparison it will be found that any difference in the ruling grades is usually the preponderating item.

(*To be continued.*)

For THE CANADIAN ENGINEER.

NATURAL VENTILATION.

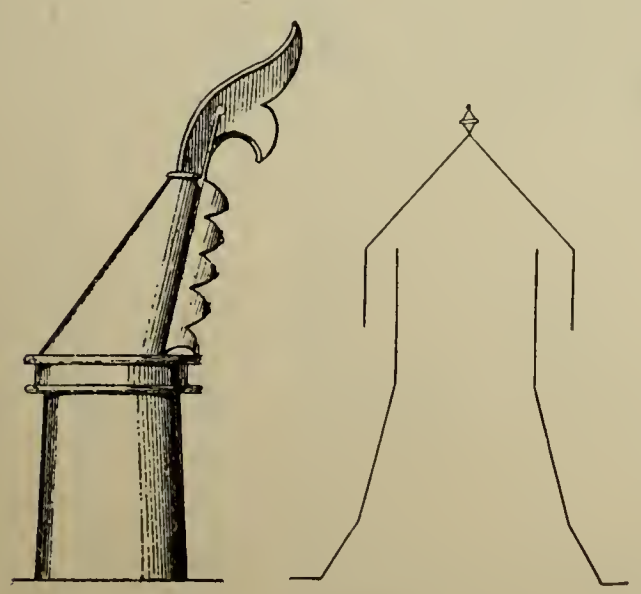
BY W. M. WATSON.

There are several means of thoroughly purifying and ventilating buildings by mechanical appliances. There is also a good method of forcing ventilation by the semi-natural process of passing the raw atmospheric air over hot steam or water pipes, which largely increases the temperature of the fresh air, causing it to expand and become lighter, and so ascending through tubes to any required room. This is only useful in cold weather, and where adopted there must be other means provided to ventilate in warm and temperate seasons. The same result is got by using a hot-air furnace in place of the steam or hot water heater, but the air after passing over the hot plates is dry, and soon injures the respiratory organs.

These methods are more or less costly; they often take up considerable room, and require attention to work them properly. Therefore it is necessary to provide natural means of purifying the interior of rooms that will be almost self acting in all weathers, that will be permanent in fixture, work mildly without creating any perceptible chilling draught; also that can be erected without curtailing any floor space, and that can be arranged at a very moderate cost, so that every dwelling, however cheaply built, can have its advantages. Such a method of purifying the air is called natural ventilation.

It has been proved that an average adult discharges $\frac{6}{10}$ of a cubic foot per hour of carbonic acid gas by respiration, together with some impurities from the skin by transpiration, and that to have a healthy atmosphere each person should have 600 cubic feet of air space, and the air of the room should be totally changed twice during the first, and three times during every other hour the person remains in the room. Common gas burners consuming 4 c. ft. per hour produce about 8 c. ft. of carbonic acid gas, which requires about 5,000 c. ft. of fresh air per hour to properly dilute it, unless some special provision is made to carry it away without allowing it to mix with the air of the room. The fumes from the light of gas made from water, and afterwards enriched by introducing kerosene oil, should never be allowed to mix with air that is to be breathed.

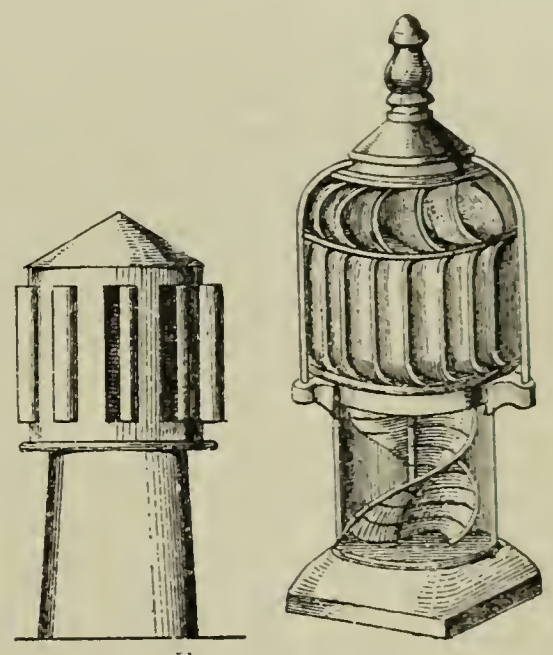
On account of the heat of the climate having a variation of about 100 degrees, it is somewhat difficult to provide natural ventilation that will answer at all seasons of the year, because it is out of the question to ventilate an apartment by bringing in air at the freezing point without first warming it; and it is equally necessary to cool the hot summer atmosphere before using it for purifying purposes.



FIGS. 1 AND 2.

During the hot season a large hole in the roof shielded from the rain, with doors and windows open, seems acceptable, or a single flued ventilator having only an up-draught which requires an air duct from the outside to bring in the air necessary to form the current, or having some window or door open to cause the air of the room to move and pass up through the tube, similar to Figures 1, 2 and 3.

Howorth invented a ventilator that drew the air from the room by a powerful screw, but it could not draw more out than was let in. It had an advantage over the plain tube ones, because it considerably increased the speed of the current, and an 18-inch Howorth's would do as much work as a 24-inch plain one. They are made so well and accurately, having a neat provision for oiling and keeping the pivot and foot-block clean, that they will run about 100 revolutions per minute for about five years in a light wind without attention. (See Fig. 4.)



FIGS. 3 AND 4.

Any kind of one-flued ventilator will answer to pass out the tainted air of dwellings that are heated by hot air, because the atmospheric air is brought into the basement to be heated, and must necessarily travel upward and out at the highest point after performing its duty. By making a by-pass from the cold air duct and the hot air flues the same ducts and air channels could be used to ventilate when no heat was needed.

In most cases, especially for private houses, natural ventilation, together with making use of such powers of extraction as can be got by utilizing the sources of warming and lighting, is sufficient, if we so arrange things that the air can take its proper share in the constant changes Several scientists have made experiments, and all agree that where no artificial means are used to move and guide the currents of air intended to purify the interior of rooms without opening doors or windows, the outside atmosphere should enter the room at the ceiling at the point where the atmosphere of the room possesses the most heat. It will, on entering, fall through the heated air (because it is heavier and denser than the hot, tainted air that is rising to pass out), down to the floor level, and during its passage will extract and absorb some of the heat from the foul air, which will take off the chill and make the fresh air pleasant to inhale by the time it gets low enough to be used by the inmates.

I am told that the ancient system can yet be seen in

many places in Egypt of ventilating by a bent tube facing the wind, similar to the ones used on steamships, being placed on the roof, the air being pressed down into the interior by the pressure of wind, which is one pound to the foot when travelling at the rate of three and a half miles per hour, but when this method is adopted on permanent buildings it is a failure, because when ventilation is most necessary there is no wind with power enough to create a current.

TABLE *to show the Discharge of Air in linear feet per minute. Calculated from Montgolfier's formula; the expansion of air being taken as 0·002 for each degree Farenheit, and one-fourth being deducted for friction. (Round numbers have been taken.)*

Height of column.	Difference between Internal and External Temperature.																							
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30
10	88	102	114	125	135	144	153	161	169	176	183	190	197	204	210	216	222	228	233	239	244	249	254	279
11	92	107	119	131	141	151	160	169	177	185	192	200	207	213	220	226	233	239	245	250	256	261	267	292
12	96	111	125	136	147	158	167	176	185	193	201	209	216	223	230	237	243	249	255	261	267	273	279	305
13	100	116	130	140	153	164	174	183	192	201	209	217	225	232	239	246	253	259	266	272	278	284	290	318
14	104	120	135	147	159	170	181	190	200	209	217	225	233	241	248	255	262	269	276	282	289	295	301	330
15	108	125	139	153	165	176	187	197	207	216	225	233	241	249	257	264	272	279	286	292	299	305	312	341
16	111	129	144	158	170	182	193	204	213	223	232	241	249	257	265	273	281	288	295	302	309	315	322	353
17	115	133	148	162	176	188	199	210	220	230	239	248	257	265	274	282	289	297	304	311	318	325	332	363
18	118	136	153	167	181	193	205	216	226	237	246	255	264	273	282	290	298	305	313	320	327	335	342	374
19	121	140	157	172	186	198	210	222	233	243	253	262	272	281	289	298	306	314	321	329	336	344	351	384
20	125	144	161	176	190	204	216	228	239	249	259	269	279	288	297	305	314	322	330	338	345	353	360	394
21	128	147	165	181	195	209	221	233	245	255	266	276	286	295	304	313	321	330	338	346	354	361	369	404
22	131	151	169	185	200	214	226	239	250	261	272	282	292	302	311	320	329	338	346	354	362	370	378	414
23	134	154	173	189	204	218	232	244	256	267	278	289	299	309	318	327	336	345	354	362	370	378	386	423
24	136	158	176	193	209	223	237	249	261	273	284	295	305	315	325	335	344	353	361	370	378	386	394	432
25	139	161	180	197	213	227	241	254	267	279	290	301	312	322	332	342	351	360	369	378	386	394	402	441
26	142	164	183	201	217	232	246	259	272	284	296	307	318	328	338	348	358	367	376	385	394	402	410	450
27	145	167	187	205	221	237	251	264	277	290	302	313	324	335	345	355	365	374	383	392	401	410	418	458
28	147	170	190	207	225	241	255	269	282	295	307	319	330	341	351	361	371	381	390	399	408	417	426	467
29	150	173	194	212	229	245	260	274	287	300	312	324	335	347	357	368	378	388	397	407	416	425	433	475
30	153	176	197	216	233	249	264	279	292	305	318	330	341	353	363	374	384	394	404	414	423	432	441	483
31	156	179	200	219	237	253	269	283	297	310	323	335	347	358	369	380	391	401	411	420	430	439	448	491
32	158	182	204	223	241	257	273	288	302	315	328	341	353	364	375	386	397	407	417	427	437	446	455	499
33	160	185	207	226	245	261	277	292	307	320	333	346	358	370	381	392	403	414	424	434	443	453	462	506
34	162	188	210	230	248	265	282	297	311	325	338	351	363	375	387	398	409	420	430	440	450	460	469	514
35	165	190	213	233	252	269	286	301	316	330	343	356	369	381	393	404	415	426	436	447	457	467	476	522
36	167	193	216	236	255	273	290	305	320	334	348	361	374	386	398	410	421	432	442	453	463	473	483	529
37	170	196	219	240	259	277	294	310	325	339	353	366	379	392	404	415	427	438	448	459	470	480	490	536
38	172	198	222	243	262	281	298	314	329	344	358	371	384	397	409	421	432	444	454	465	476	486	496	543
39	174	201	225	246	266	284	302	318	333	348	362	376	389	402	414	426	438	450	461	471	482	492	503	551
40	176	204	228	249	269	288	305	322	338	353	367	381	394	407	420	432	444	455	467	477	488	499	509	558
45	187	216	241	264	286	305	324	341	358	374	389	404	418	432	445	458	471	483	495	506	518	529	540	591
50	197	228	254	279	301	322	341	360	377	394	401	426	441	455	469	483	496	509	522	534	546	558	569	623
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30

To use the table, determine the height of the warm column of air from the point of entrance to the point of discharge. Ascertain the difference between its temperature and that of the external air. Take out number from table, and multiply by the section area of the discharge-tube or opening, in foot or decimals of a foot. The result is the discharge in cubic feet per minute, multiply by 60—result, discharge per hour. *Example*—Height of column, 32 feet; difference of temperature between internal and external air, 17 deg. Looking in the table, we find opposite to 32 and under 17,375 feet. That would be for an area of 1 square foot.

But supposing our air opening to be only ¾ of a foot, we must multiply 375 by ¾ or 0·75 of a foot.

$$\begin{array}{r} 375 \\ \cdot 75 \\ \hline 1875 \\ 2625 \\ \hline 281\cdot25 \end{array}$$

Therefore we get 281 feet (per minute), multiplied by 60 = 16,860 feet per hour.

With a view to prevent wind acting upon the currents all air ducts should be bent, having two or more elbows, and the mouth should either face up or downward. To avoid the chilling sensation of drafts when ventilation is secured by air ducts, the inlet should be sufficiently large to allow the necessary quantity to enter the room slowly, say about the rate of one mile per hour, and the inlet should be larger than the outlet. It is the size of the outlet that regulates the quantity of air entering and passing out of a room. Therefore it is necessary to know the size of tube or valve required to pass the proper quantity of air. Montgolfier's formula gives a valuable table showing the size needed under many variations between the temperature outside and inside, and also the height of the rooms, which will answer if the inlet end of the air duct is well shielded against the pressure of wind.

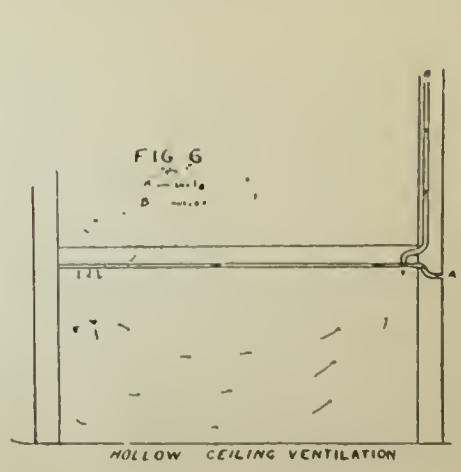
It is not necessary to make channels large enough to pass all the air needed, except the house be as tight as a glass show case, because there are generally streams of air passing in and out of the chinks of windows and doors, and even walls and plaster, except they happen to be painted and papered. Marcker proved by experiments that the following amount of air passes in one hour through a square meter of wall when the difference in the temperature was only 1° C., viz.: Sandstone, 1.69; limestone, 2.32; good brick, 2.83; loamy brick, 5.12, and that it increased in the ratio of the increase in the difference of the temperature between the outside and the interior.

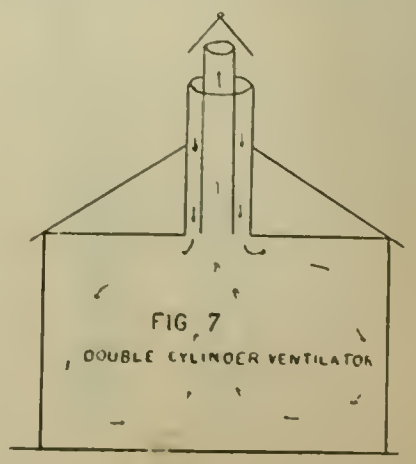
No doubt the best way to venti'ate is by bringing in the fresh air at or near the ceiling at one end of the room, and extracting the tainted air at or near the floor line at the opposite end of the room, but this can only be done when an exhaust fan is used or there is a long chimney at least three times the height of the room. And even when a chimney is used, some method should be made to create some artificial heat at the bottom, to increase the draught at times when the temperature is nearly equal inside and out, because of the resistance to be overcome in drawing down the warm air in the room.

Dwellings can be simply and well ventilated by leaving all the interior partition walls two inches short of the ceilings, so that the air of every room can freely pass slowly out in long thin volumes into the entrance hall and staircase well. Then fix one double draught ventilator with a 24 to 30-inch body over the well on the roof. This will keep the air fresh and pure.

When a house is in course of erection a proper system of ventilation can be made for each room separately by building the outside walls hollow, having a 4-inch space carefully plastered smooth on both sides inside. This space would greatly benefit the house by keeping it warmer in winter and cooler in summer, but the space would also answer for an air duct leading to every room which would convey the necessary amount of air in slowly and cool the current a little in summer and warm it in winter. To draw off the tainted air of each room the main chimney should be so built as to be handy for inserting every tube drawing the foul air from the rooms, also handy to receive the smoke pipes serving all the needed fires. There should be a wrought iron tube inside the chimney, with branches to receive the smoke. Round the smoke-tube there should be about 6 inches of space to act as an air flue, and into that air space all air ducts should be carried. The chimney should have a couple of slow-turned elbows near the top in order to prevent the pressure of the outside atmosphere bearing its weight down the full length of the chimney, injuring the chimney efficiency. A straight vertical chimney or air flue is of little use for creating a draught, except it is carried to a great height, besides having plenty of heat or a forced draught at the bottom.

The space between joists could be made useful for bringing in and tempering the incoming current in winter, or better still, if the ceilings could be made with two plates having a half-inch space between, coupled at one end of the room with the outside atmosphere, by a long bent flue, and pierced with holes at the other end of the room to allow the fresh air to enter. The fresh air while travelling between the two ceiling plates across the top of





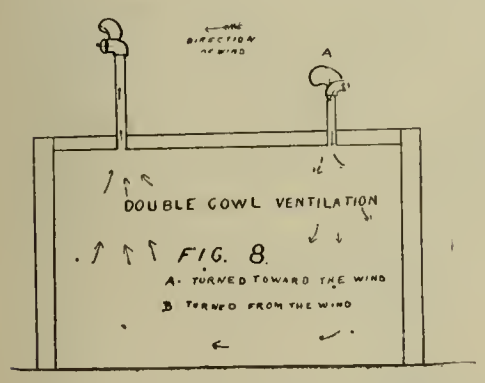
the warm room would increase in temperature so much that very little heat would be lost by changing the atmosphere of the room twice an hour (see fig. 6). By this method the extractor would have to be so arranged that it would have a keen draught.

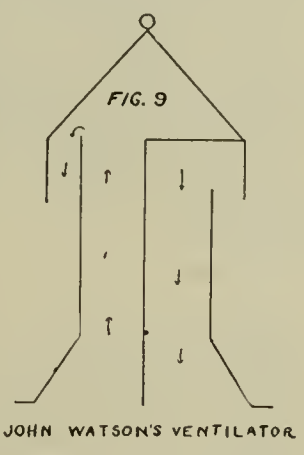
Potts describes a similar system of ventilation to this by having a hollow cornice round the room, with a double row of holes, one row connected to the outside air and the other row connected with a heated flue of a chimney, and the system worked well.

Seventy years ago Sylvester used a hot air furnace of a far superior type, and more economical with fuel than any of those made at the present day to force ventilation and warm houses. His stove had plenty of wing plates that increased the radiating power. He placed a large pipe finishing with a cowl a little distance from the building, where it could face the wind in which ever direction it happened to blow, at a height of about six feet from the ground. The wind entering the cowl continued on through an underground channel to the basement of the house, where it entered a chamber containing a stove which heated the air and conveyed it through pipes to each room.

McKennell ventilated by placing two cylinders in the ceiling, one inside the other, the inner one terminating about 6 inches higher than the outside one. The space between the two tubes was equal to the area of the inside cylinder. By this method he caused an in and out draft by one machine. (See Fig. 7).

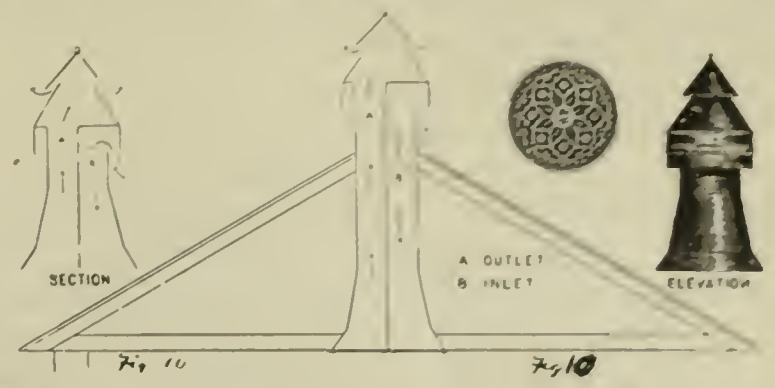
Arnott took advantage of the unequal density of the masses of air at different elevations. He ventilated by placing two moving cowls on the roof, one arranged to face the wind and the other to face the way it was blowing. The one that faced the wind was set several feet lower than the other and formed the inlet; the high one that faced the way the wind was going made a good ex-





tractor. The machine was valuable for large meeting rooms. (See Fig. 8).

The late John Watson crystallized some ideas and built a double current ventilator having a compact and graceful form. It had a perfectly air tight division vertically through the centre, the half moon shaped tube on one side terminating about 6 inches higher than the other side. (See Fig. 9.) This little difference in the height of the half tubes caused an inlet and outlet action. These ventilators are at present purifying the air of many of the English public buildings. The first time I fixed this class of ventilator I considered Mr. Watson did not get all the work out of his design that he might, and I afterwards designed one that gave a space of 30 inches between the inlet and outlet, by so doing increasing its extracting power. (See Fig. 10). I made a small one with an 8-inch body to test with, and fixed it on an air-tight glass show case containing 8 cubic feet of air space. Inside at the bottom of the case were placed four lighted gas burners, burning 5 feet per hour each. I fixed wires with feathers attached all over inside the case to indicate the way the air moved. The case was outside for a week during one of the coldest spells in winter. The test proved that the air dropped to the floor level, penetrating every corner of the case; then,



after making a circular tour, it again passed to the outside up through the other half of the ventilator. The whole of the glass of the case and the down draught half of the ventilator kept cool all the time, while the upcast side was hot. And if passage of air stopped the lights would at once die out.

None of the systems of ventilating that I have here described are covered by patents, and if the reader fancies any of them he can use the ideas freely, and I hope improve them, and then give publicity to his ideas.

For THE CANADIAN ENGINEER.

THE OTTAWA VALLEY CANAL.

BY ANDREW BELL, C.E.

When referring to the scheme—now exciting so much interest—to construct a deep-water canal via the Ottawa River to Georgian Bay, it is now well recognized that the most difficult engineering problem to be solved is how to get deep water on what is generally called the Lower Ottawa—say between Lachine and Arnprior. That part of the river flows over flat limestone rock, consequently the still water reaches are wide and shallow—the shallowest parts often extending some distance up and down stream—and this difficulty seems to be greatest towards the lower end, namely, from a short distance above Lachine to above St. Ann's—due, but only partly, to the river dividing above the latter place, and the larger part going north of the Island of Montreal. At present not more than 8 feet depth for navigation can be depended upon between Lachine and Ottawa city in low water.

The rapids between Lachine and Arnprior are St. Ann's, 3 ft. fall; Carillon, 16 ft.; Long Sault, 44 ft.; Chaudiere and Des Chenes, 60 ft. (about); and Chatts, 40 ft.

Deep water can be made by raising the surface, or by lowering the bottom, or by both.

As the banks of the lower river are generally low and thickly settled, raising the surface permanently, even a few feet, seems to me to be totally out of the question. The dams would be extremely expensive to construct and expensive to keep in repair; the raising of the water would be resisted to such an extent as to almost cause a rebellion, besides destroying the appearance and value of a large area of country. Where it is possible to widen the channel for high water by excavating the banks above low water marks, low dams could be put in at head of rapids to such an extent as can be compensated for by that widening for high water; thus raising low water but keeping down high water to its original height. Two or three feet might be gained in that way for low water, and the low dams would enable the water to be "laid hold of" for power purposes.

To get the required depth, over the part of river referred to, lowering the bottom where necessary must be generally resorted to in some manner. Where the shal-

lows are earth they can be dredged ; where they are rock, as is generally the case, if short they can be sub-marined; if long, resort must be had to excavation inland, or along shore, where the expense of un-watering is the least.

The question cannot be settled until more and better information is obtained, based on the changed conditions of the present proposals. All the surveys heretofore made for canalling the Ottawa only looked for 10 or 12 feet deep. I made extensive surveys in 1870-82 from above Grenville to below Carillon, and also (by an assistant), above and below St. Anns, but my instructions only required me to look for 10 feet depth. The public would not be satisfied in the new scheme with less than 20 feet. Careful and exhaustive surveys must be made and from them the best solution of the problem studied out, when it is to be hoped the difficulties will, to a great extent, disappear.

It may be found best to take the canal by way of the Back River from Lake of Two Mountains, instead of by Lachine and Montreal. The rapids can be overcome as is done at present below Ottawa, by excavating channels along shore, either a little inland or by " fencing in " part of the bed of river at the shore.

There is considerable difference between high and low water in the Lower Ottawa. This varies at different places, being least at Carillon, where it averages about 10 feet. By making deep water on the middle parts of the canals around rapids, that is, the parts where the surface is not effected by the rise and fall of the river, there would at present be 20 feet navigation in high water, and 12 to 15 feet for a considerable part of the season. Unfortunately, as the navigation is most required at the time of the year when the water is lowest, not much would be gained by utilizing high and medium water in that way, but it might be adopted to some extent while work at deepening the slack water stretches was in progress, which will necessarily be slow.

Above Arnprior the river flows through laurentian rocks. The banks are generally high and as yet thinly populated. The slack water reaches are almost always deep, and shallows, where they occur, are mostly short. The channels at rapids are narrow, and all conditions for damming good ; so that where deeper water than exists is wanted it can be obtained by raising the surface where that is found to be cheaper than excavating.

The amount of water power which can be developed is an interesting subject, but is little known. From a series of measurements I took at Carillon, between 1872 and 1882, with rather imperfect appliances, I made out the flow of the river there to be in very high water 200,000 cubic feet per second, and in extreme low water, 25,000 cubic feet per second, ordinary low water being about 30,000 to 35,000 cubic feet per second. When the Ottawa canal is made the dams which must be built on the Upper Ottawa will of course regulate the flow by retaining a portion of the spring floods for use during low water. It is safe to say that this will be done to such an extent that at least 42,000 cubic feet per second can be depended upon as the lowest at any time of the year between St. Ann's and Mattawa. That would give, taking 20 per cent. off for loss in application, 4,000 horse power per foot fall. The tributaries emptying into the river between the points mentioned should give about a quarter more in the vicinity of the Ottawa before they fall into it. That would make on the Ottawa, from Mattawa downward and its branches, close to main stream, about 2,500,000 horse power to be depended on all the year round—not including the extra power which might be developed for three months or more during high water.

ONTARIO AND ALASKA.

We Canadians are so used to the idea of our vast territories and their boundless wealth that we feel deep annoyance at times to find that some foreigner, or even traveller from the motherland, is not familiar with our riches. Now we find ourselves with new discoveries every day, and look back on our former knowledge of our country's greatness in much the same way as we look on the foreigner's total ignorance of it. The lands which some of us thought to be producing a good crop when we read over the report of the Hudson's Bay fur sales, are now known to be as valuable as any in all our wide Dominion.

There are two great obstacles to the development of our northern regions, the rigor of the climate, and the enormous distances to be traversed. If facilities could be provided for rapidly handling the freight and passenger traffic of these regions during the warm season, the extreme cold of the winter months would not be so serious a handicap. At present all eyes are turned toward the Klondyke, and there is, therefore, the more interest in considering the prospectus of the Sault Ste. Marie and Hudson's Bay Railway Co., which proposes not only to reach the Klondyke, but to open up the million and a-quarter square miles of lands which lie in the basin of the Mackenzie river, which abound, as we know they do, in timber and fish, and contain coal and petroleum areas unapproached elsewhere upon the globe.

The resources of this country were examined into by a select committee of the Senate of the Dominion of Canada, and a report published by authority of Parliament in 1888. The committee was appointed to enquire into the resources of that part of the Dominion lying north of the Saskatchewan watershed, east of the Rocky Mountains, and west of Hudson's Bay, and comprising the Great Mackenzie Basin—its extent of navigable rivers, lakes and sea coast, of arable and pastoral land, its fisheries, forests and mines, and to report upon its possible commercial and agricultural value. The committee reported that the Mackenzie Basin comprised an area estimated at 1,260,000 square miles ; also that the three great lakes, Athabasca, Great Slave Lake, and Great Bear Lake, have navigable coast lines of over 4,000 miles, with an area probably exceeding that of the great lakes of the St. Lawrence Basin, excluding Lake Michigan. That there are 2,750 miles of navigable water in the Mackenzie River and main tributaries, of which 1,360 miles are north of the rapids of the Great Slave River, and can be navigated by ocean steamers of medium draught.

The eastern extremity of Great Slave Lake is only a short distance from the navigable waters of Hudson's Bay. The report stated that within the Mackenzie River there is a possible area of 656,000 square miles fitted for the growth of potatoes, 407,000 square miles suitable for barley, and 316,000 square miles suitable for wheat. That there is a pastoral area of 860,000 square miles, 26,000 miles of which is open prairie with occasional groves, the remainder being more or less wooded; 274,000 square miles, including the prairie, may be considered as arable land. That about 400,000 square miles of the total area is useless for the pasturage of domestic animals or for cultivation. This area comprising the Barren Grounds and a portion of the lightly wooded region to their south

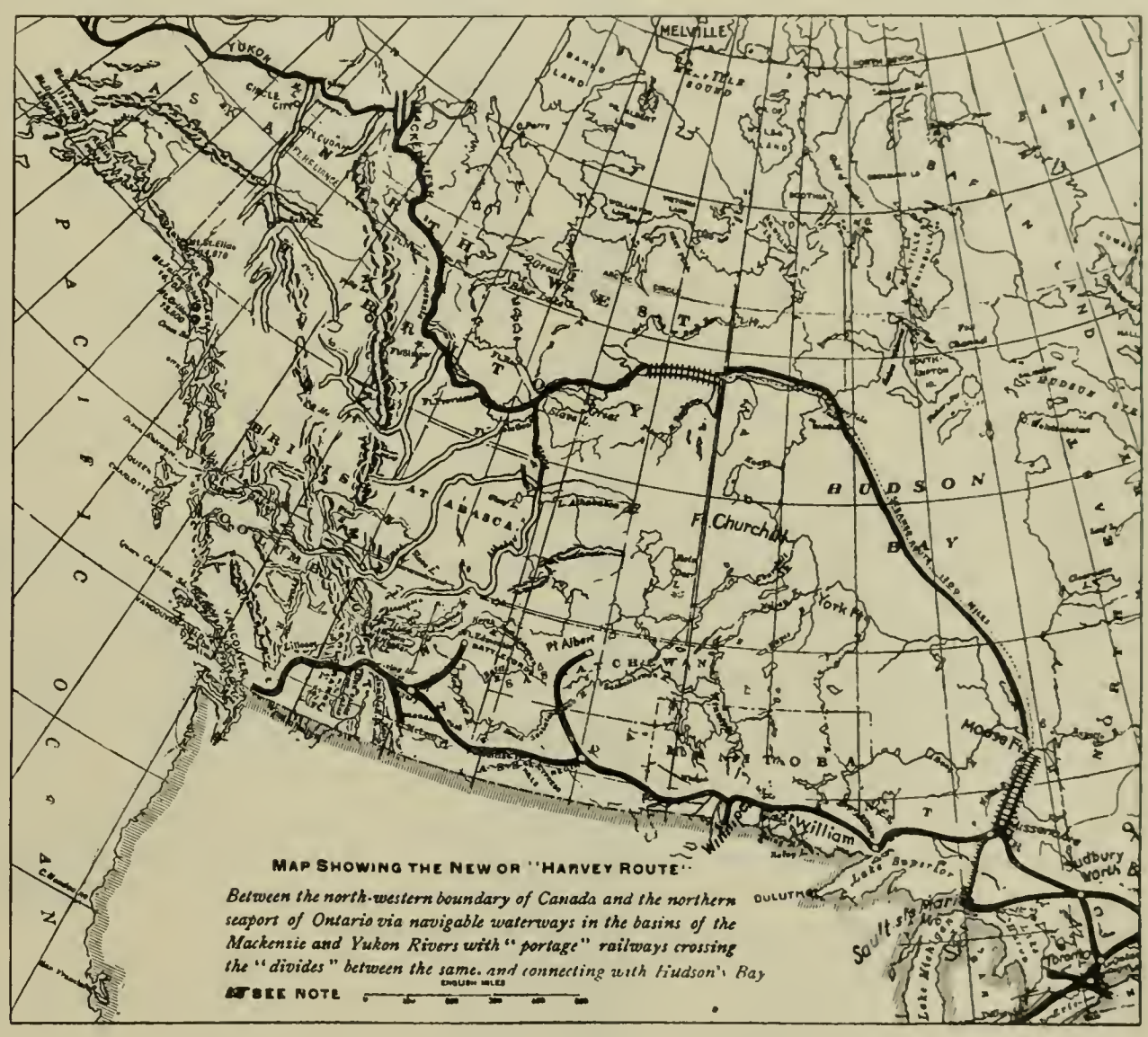
and west. That throughout this arable and pastoral area latitude bears no direct relation to summer isotherms, the spring flowers and the buds of deciduous trees appearing as early north of Great Slave Lake as at Winnipeg, St. Paul and Minneapolis, Kingston, or Ottawa, and earlier along the Peace, Laird, and some minor western affluents of the Great Mackenzie River, where the climate resembles that of western Ontario. That the native grasses and vetches are equal and in some districts superior to those of eastern Canada. That the prevailing south-west summer winds of the country in question bring the warmth and moisture which render possible the far northern cereal growth, and sensibly affect the climate of the region under consideration as far north as the Arctic circle and as far east as the eastern rim of the Mackenzie Basin.

Fish were found in abundance and salmon in nearly all the rivers.

The forest area, the report says, has upon it a growth of trees well suited for all purposes of house and shipbuilding, for mining, railway and bridging purposes, far in excess of its own needs, and of great prospective value to the treeless regions of Canada and the United States to the south, the growth on the Laurentian formation being scant, but the alluvial portion has upon it the "Liard," a balsam poplar, sometimes called Balm of Gilead or rough bark poplar, 120 feet high, with a stump diameter of five or six feet. The *white spruce*, 150 feet high, with a stump diameter of four to five feet; the *larch* of about the same size, and the *banksian pine*, whose straight stem is often 100 feet long, with only two feet of diameter at the stump.

This is the country to which we wish to secure ready access. The route proposed is shown by the accompanying map. From Missanabie on the C.P.R., to Moose Factory on James' Bay, the southern extremity of Hudson's Bay, is 250 miles; from Moose Factory to the head of Chesterfield Inlet, the north-western extremity of Hudson's Bay, is 1,300 miles of deep water navigation; from the head of Chesterfield Inlet to Great Slave Lake is not more than 175 miles, where a portage railway would be built; from Great Slave Lake to the mouth of the Mackenzie River is 1,400 miles; a railway line 50 miles long would connect the mouth of the Mackenzie river with the Porcupine, a branch of the Yukon, which affords navigable water for 1,500 miles to the Behring Sea.

The line from Missanabie to Moose Factory is estimated to cost $30,000 per mile, or $7,500,000, and this sum it is proposed to raise partly by means of land and money grants which are to be asked from the Ontario and Dominion Governments on the following conditions: First—That no payments should be made until a considerable part of the work was actually done, and that a large reserve should be made until the road was actually finished to Hudson Bay. Second—That the stock control of the enterprise should be deposited in Toronto as a trust, and that it should be retained in that condition until the railway was completed and open for traffic. Then that the Dominion Government, and after that the Provincial Government, and following these the citizens of Canada and of Toronto, should have an opportunity of taking a controlling interest in the stock at par, which should be valued in the construction operations at the same rate.



The charter under which the first line in this new chain of connection is to be built was granted to a number of Sault Ste. Marie men seven years ago, and was transferred by them a short time since to a group of well-known Toronto capitalists, among whom are Stapleton Caldecott, S. H. Blake, J. W. Langmuir, Robt. Kilgour, and James Scott.

The engineer in charge of the preparatory work is Charles T. Harvey, C.E., whose work is well known in connection with a number of important works.

THE DEEP WATERWAYS QUESTION.

Tne United States commission appointed to consider the question of an international deep waterway route from the Great Lakes to the sea has reported to Congress, and the Canadian commission appointed to co-operate with the American commission have also sent in their report. The

American commissioners' report was promptly published and sent to the Canadian Government, but the Canadian report, though rendered last June before Parliament prorogued, has not yet seen the light. This is much to be regretted, because apart from the fact that the Canadian public should be in a position to study this question, it is demanded by international courtesy that the American Government and public should have the same prompt access to the information gathered by the Canadian commissioners as they have given us of theirs. To delay the Canadian report would appear all the more strange, seeing that the Minister of Railways and Canals has himself reprinted the American commissioners' report in his own departmental blue book.

Following up their commissioners' report, the United States Congress has appropriated a further sum of $150,000 for new surveys bearing on the contemplated international deep water channel to the seaboard. These new surveys will be in charge of a commission more exclusively composed of engineers, the commercial aspect of the case having already been fully gone into in the last report. It is thought that the Canadian Government will co operate in these new surveys, and then the question of the cost of the deepening and the further question of control and regulation of the proposed great water route will be considered. It is to be hoped that our Government will not lose any more valuable time in dealing with a subject of such great importance to the marine interests of Canada.

Meantime, it may be observed that a commission of military engineers appointed by the U.S. Government have enquired into the question as to how the levels of the Upper Lakes will be affected by the Chicago drainage canal, and have condemned the scheme as likely to have a serious effect on the navigation of the Great Lakes. If it is found that the City of Chicago, by creating a large river here—for that is what the new canal means—causes the lowering of the lake levels, the Government will step in and compel the city to reduce the flow of water to the limits of safety. Happily for Canada, there are more populous cities on the American shores of the Great Lakes that would be damaged or ruined by the Chicago canal than on the Canadian shores, and the international riparian rights, as well as the local commercial interests all along the lakes and rivers, combine to make an influence that will outweigh the selfish interests of even a Chicago. So we may hope that the American Government will not allow Chicago to lower the lakes by a single inch; for the deepening of the canals from the Great Lakes to the ocean will be as important for that emporium as for the other cities and towns scattered along the shores of these vast fresh water seas.

Last month the American Government received a report from Major T. W. Symons, of the U. S. Corps of Engineers, a preliminary report on the question of a ship canal to the sea exclusively through United States territory. A synopsis of the report will be found in another column.

THE VICTORIA JUBILEE BRIDGE AT MONTREAL.

When the present Victoria Tubular Bridge across the River St. Lawrence at Montreal was built, it created at the time universal admiration for its noble proportions and the skill displayed by its engineers, as well as amazement at its gigantic size and stability—in fact it was looked upon as one of the wonders of the world. Built between 1854 and 1859, and with little or no precedent for many important details connected with the structure, one is bound, even at this day, to acknowledge the wisdom and foresight of the engineers and contractors who planned and built it. Far-sighted, however, as the promoters of this bridge were, in regard to details of construction, the most sanguine of them, in all probability, never realized that within thirty years from its opening the demands upon its capacity would be so great as to make a larger structure a necessity. This need has been specially felt in recent years, as the traffic of the Grand Trunk Railway developed and increased so enormously, and, as far as the bridge itself is concerned, will the more easily be understood when it is considered that over eighty trains pass through the bridge during the twenty-four hours. It is well known that the passage of trains through the bridge has always been conducted on the absolute block system, and no train received orders to proceed through until the preceding one had reported to the telegraph station at either end.

This famous bridge will soon only be a matter of history, for it is about to be replaced by one modern in design, built in accordance with the best practice of the present day, and of accommodation sufficient probably to meet all future requirements. The superstructure of the bridge which is to replace the present tubes, will consist of twenty-four spans of pin-connected, through, steel trusses, each of a length of 254 feet between centres of end pins, and one span of 348 feet over the steamboat channel. The trusses will carry two railway tracks to be used by ordinary steam railway trains, as well as by electric railways, and the floor beam system will be extended beyond the trusses of sufficient length for an ordinary vehicle roadway and sidewalk on either side. The clear width between the trusses will be 28 feet. For each railway track there will be four lines of stringers, spaced two feet five and a half inches from centre to centre. There will also be two lines of stringers for each roadway, and one line placed at the ends of the projecting beams for the support of the outer edge of the sidewalk. The clear headway from the base of track rails to the struts under the overhead lateral bracing will be 22 feet.

The trusses have been proportioned to carry the undermentioned loads:—

First.—The total weight of metal in them.

Second.—The weight of the wooden floor beams, planking, sidewalks, guard timbers, railings, rails and fastenings, etc., amounting in the aggregate to 2,800 lbs. per lineal foot.

Third.—A moving load in either direction on each side of the two tracks, of two consolidation engines and tenders, coupled, followed by a uniformly distributed load weighing 4,000 lbs. per lineal foot, or 100,000 lbs. equally distributed on two pairs of driving wheels spaced 7½ feet centre to centre.

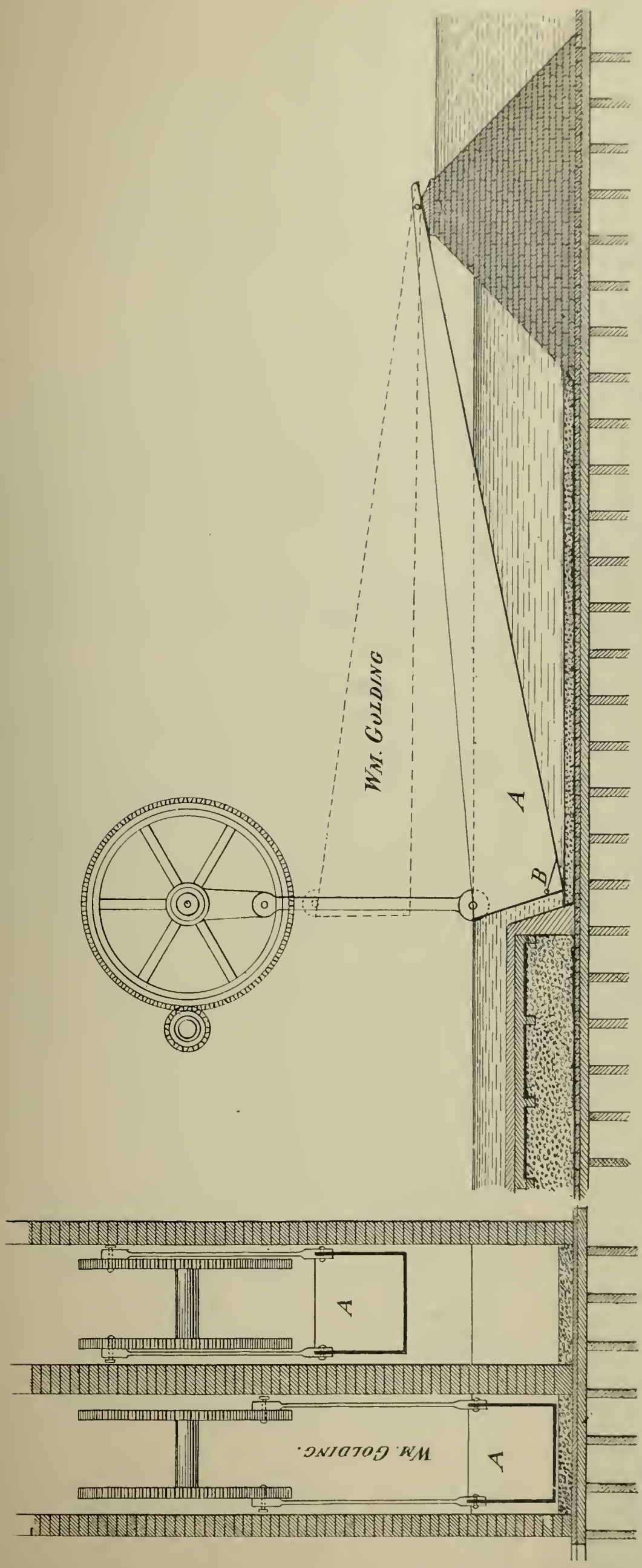
Fourth.—A moving load in either direction on each of the roadways of 1,100 lbs. per lineal foot.

Fifth—A live load on each foot-walk of 200 lbs. per lineal foot.

The trusses are now under construction by the Detroit Bridge and Iron Works, and the Dominion Bridge Company. Of the 25 spans, 19 will be turned out by the former company, and six by the latter.

At the present time the masonry of the piers is undergoing the extension necessary to meet the requirements of the enlarged bridge. It is expected that work will be commenced on the erection of the new bridge about the middle of August, and it is the intention to have the whole of the work completed by the 1st June, 1898.

On the application of Edward Major, a creditor, an order of the court has been granted for the winding up of the Canadian Mineral Wool Co., of Toronto, as insolvent.



For The Canadian Engineer

WATER LIFT.

This sketch illustrates a new system of water lift, which is claimed to be especially adapted to the displacement of heavy fluids, and in shallow lifts will have the advantage in not having to raise the water any higher than required to effect the discharge. The sketch is one sixteenth to the foot of a combination to discharge 500 cubic feet per second over an embankment six feet high.

There are two wedged-shaped dippers, *A*, pivoted at the small end and suspended by lifting arms at lower end. There are 4 spur wheels which form the cranks, there is also a cross shaft upon which are secured 4 pinions, which engage the 4 spur wheels in such a manner as to require one of the dippers to descend while the other is coming up, thus effectually balancing the dippers and all other parts. A large valve is placed at *B*, through which the burdened water enters while the dipper is descending.

The motive power will be applied to the pinion shaft in any manner deemed best. This lift is the invention of Wm. Golding, New Orleans, Va.

NATIONAL CONVENTION OF MASTER PLUMBERS OF CANADA.

The first four days in July were marked by the meeting of the Master Plumbers of Canada in Toronto for their second annual convention. There were thirty-four delegates present against eighteen last year at the first convention. The representation was one delegate to every ten members. The following delegates were present:

Quebec—R. Sampson, A. Forrest, J. R. Cane, J. O. Matte, A. Pickard. Montreal—Thos. Moll, E. C. Thibault, J. W. Harris, John Watson, P. C. Ogilvie, Arthur Martin, P. J. Carroll, E. C. Mount, Wm. Briggs, J. W. Hughes, joseph Lamarche. Windsor, Ont.—M. B. Squires, Halifax—John Borton, Geo. A. Perrier. Ottawa—John McKinley, F. J. Johnson. St. John, N.B.—W. H. Dunbrack, J. H. Doody. St. Catharines—J. A. Caslake. Toronto—J. B. Fitzsimons, Joseph Wright, A. Purdy, H. Beavis, J. K. Allison. Winnipeg—J. W. Hughes. London—W. H. Heard, W. Smith, E. Holland, Benjamin Noble. West Toronto Junction—Represented by the five Toronto delegates. St. Thomas—W. Flaherty. Peterborough—Adam Hall. The Executive Committee reported that during the year local associations in affiliation with the Dominion Association had been organized in Winnipeg, Man., and Windsor, Stratford, St. Thomas, and St. Catharines, Ont. Negotiations are now going on that will, it is hoped, result in the formation of an Association in Vancouver, B.C.

Notice was given of a motion to form Provincial organizations, each to be part of the larger association, whose officers would then be known as the supreme officers.

Drafts of by-laws which the association will endeavor to have passed in the various municipalities were submitted to the association. They comprised by laws to license and regulate plumbers; to provide plumbing inspectors, plumbing examiners and their duties. The legislative committee reported against the proposed incorporation of the association.

President Lamarche reported the progress of the association during the first year of its existence. A great deal of work had fallen on the officers, and a great deal of correspondence had been necessary in perfecting their organization. The resolution of the master plumbers had been signed by most of the wholesale dealers in Toronto, Montreal and Quebec. He urged the members to be most careful in sending the names of all master plumbers in their neighborhood, so that the wholesale men should know the names of all the master plumbers. The president said: "Too much trouble cannot be taken to see that this is carried out, as the wholesale men are not able to distinguish between master plumbers, journeymen plumbers and contractors. If a man comes in the store with his money, calling himself a master plumber, the wholesale man will not nor cannot take time to go after possible information to see if he is the right man to whom he should sell. It is, therefore, our duty to see that they receive a complete list of *bona fide* master plumbers, monthly notices of changes, and the deserved help from us. Complaints of the agreement

being broken should always be very carefully made and positive proof sent in to the National office. It alone has a right to deal with trade relations which have been decided by the convention."

The new officers elected are :—President, Joseph Wright, Toronto; vice-president, W. Smith, London; vice-president for Ontario, John McKinley, Ottawa; vice-president for Quebec, P. J. Carroll, Montreal; vice president for New Brunswick, J. H. Doody; vice-president for Nova Scotia, John Borton, Halifax; vice-president for Manitoba, —. Irwin, Winnipeg; secretary, —. Mansell; treasurer, W. Briggs, Montreal; executive committee, one from each Province – Ontario, J. B. Fitzsimons, Toronto; Quebec, Arch. Picard, Quebec; New Brunswick, Thomas Campbell, St. John; Nova Scotia, Geo. A. Perrier; Manitoba, —. Stevenson, Winnipeg.

The social features of the convention included a drive given the members by the city, a banquet and a trip to Niagara Falls. The banquet was a magnificent affair, and was held in the Harry Webb Co.'s building, Yonge and Melinda streets. About 140 members and guests sat down to a dinner which was beautifully served and in which every dish was well worth the serving. Chairman Burroughes opened the toast list and a couple of hours were spent in speeches and song.

DETERMINATION OF THE HEATING POWER AND STEAM-PRODUCING VALUE OF COALS FROM A PRELIMINARY EXAMINATION.*

BY WILLIAM THOMPSON, MONTREAL WEST.

The principle of getting the best returns and most efficient service should underlie our system of purchasing our fuel, as of anything else. It is not my intention to discuss the merits or demerits of any particular variety of coal, but to try to establish a method whereby the heating power, and consequently, the value of any fuel, can readily be determined, and when the knowledge of conditions under which combustion must take place are understood, we shall, in some measure at least, be able to intelligently choose between any number of samples and varieties of coals that are most suited to our purpose. Undoubtedly the most correct method of determining the actual heating power of any substance is by the aid of the calorimeter, but when we consider the high cost and delicate manipulation required in an instrument of this kind, we find it is practically debarred from use, except by the expert chemist in his laboratory. Efforts have been made by scientists to construct a formula whereby the actual heating power of coals could be accurately ascertained by computation. That published by Dulong and also by Mahler, is perhaps the best. It is based upon an elementary analysis of the coal under examination, and the fact that the heating powers of coals of a like composition remained constant. They also establish the fact that the heating power of fixed carbon remains constant, as does also that of hydrogen when in combination with the same proportions of oxygen and nitrogen. Dulong accepts as the heat-producing elements of coal, carbon and hydrogen, giving each a constant calorific value, and at the same time determined that the oxygen of the coal renders unavailing for heating purposes one-eighth of its own weight of the hydrogen, and on this basis constructs the following formula :

$$Q = 14{,}544\ C + 62{,}100\ (H - O_8)$$

which for convenience might be written :

$$Q = 14\ 544\ C + 62{,}100\ H - 7{,}762.50$$

Where Q equals calorific value of fuel,

14,544 = constant heating power of carbon
62,100 = " " " hydrogen
7,762.5 = " neutralizing power of oxygen

Mahler, at more recent date, and after a series of lengthy experiments, amended Dulong's formula slightly by accepting Berthelet's more recent determination of the heating power of carbon as 14.52 B.T.U., and using the empirical constant, 5,400, at the same time taking note of the effect of nitrogen as well as that of the oxygen. Mahler's formula then became :

$$Q = 14{,}652\ C + 62{,}100\ H - 5{,}400\ (O + N)$$

Where Q equals calorific value of coal,

14,652 = constant value of carbon
62,100 = " " hydrogen
5,400 = " neutralizing effect of oxygen, less heat formed by formation of nitric acid, ($N_2 O_5 + H_2 O$) †

*Abstract of a paper read before the Canadian Electrical Association.

† $N_2 O_5 + H_2 O = 2\ H N O_3$. The calorific value of 1 lb. nitric acid equals 187.79 B. T. U.

Both of these formulas are based upon an elementary analysis, which is difficult to make, and will give an inaccurate result, unless conducted by a chemist, experienced in this class of work. Consequently we must look for a formula constructed on the basis of a proximate analysis. An elementary analysis of coal is a definition used when it is understood that the whole of the elements composing the coal are determined and separately enumerated. A proximate analysis determines the moisture, volatile combustible matter, fixed carbon, and ash. The volatile combustible may consist of several elements, but is chiefly composed of carbon and hydrogen in combination as "hydro-carbons." This carbon is hereafter usually referred to as volatile carbon, and the carbon remaining in the free or solid state is referred to as fixed carbon. For example, the coke from gas works contains fixed carbon plus ash.

M. E. Goutal published in Progressive Age, Jan. 15, 1897, the following formula :

$$Q = 14670\ F.\ C + A \times \text{volatile matter.}$$

when Q equals calorific value of coal.

14670 = constant heating power of fixed carbon,
A = 23400 when volatile matter equals from 2 per cent. to 15 per cent. of total combustible.
A = 18000 when volatile matter equals from 15 per cent. to 30 per cent. of total combustible
A = 17100 when volatile matter equals from 30 per cent. to 35 per cent. of total combustible.
A = 16200 when volatile matter equals from 35 per cent. to 40 per cent. of total combustible.

This formula may be taken as useful for the calorimetric value from a proximate analysis of coals of an anthracite, semi-bituminous and bituminous nature, but should not be used in cases where the volatile matter exceeds 35 per cent. of total combustible.

Up to this point I have dealt entirely with the estimation of the actual calorimetric value of coals. This, however, does not give us the information we require as engineers. Experience teaches us that there is often a wide difference between the industrial value of bituminous and anthracite coals, owing apparently to the increased percentage of volatile matter in bituminous varieties. A review of Mahler's calorimetric tests shows the interesting fact that the total calorimetric values of coals vary but little, and that a decrease of fixed carbon does not reduce the heating power of the coal in proportion to the increase of volatile combustible matter, while on the other hand repeated tests prove that the industrial value of coals decreases almost in the same proportion that volatile combustible increases.

We can safely take it as an established fact that the heating power of fixed carbon will remain constant. The same can be said of hydrogen in the absence of oxygen in the combustible, and the heating value of the hydrogen in the combustible will decrease in proportion to the increased percentage of oxygen within the combustible. Both Dulong and Mahler recognize this fact, and construct their formula accordingly. The actual calorific value of coals decreases in nearly the same proportion as the neutralizing effect of the oxygen on the hydrogen increases, and that the industrial heating value of the coals under the boiler decreases as the proportion of volatile carbon increases. We have this strongly exemplified in our daily practice. It requires but ordinary observation for us to readily see that anthracite coals produce practically no smoke, semi-bituminous coals very little, while bituminous coals produce dense, black clouds of smoke, varying in density and volume according to the quantity and composition of the volatile combustible matter in our fuel.

It has been said that the industrial value of a coal for steam-making purposes is practically fixed by the percentage of fixed carbon in the fuel, but we cannot take this method of determination as a permanent basis for calculation with any degree of accuracy. It has been established fairly satisfactorily, however, that volatile matter of similar composition will give off like quantities of heat. The adoption of the principles underlying Goutal's formula, and multiplying by the average percentage of efficiency of the various classes of coals for industrial steam-making purposes, as determined by Schurer-Kestner on European coals and Johnston on American coals, leads me to the belief that a formula constructed as follows will be of especial

benefit in enabling engineers to arrive at the steam-making capacity of their coals .

$$Q = 14652 \text{ c} + \text{A} \times \text{volatile matter} \div \text{B}.$$

Where A equals 23,400 when volatile combustible is equal to from 2 to 15 per cent. of total combustible,

A equals 20,000 when volatile combustible equals from 15-30 per cent. of total combustible,

A equals 17,100 when volatile combustible equals from 30.35 per cent. of total combustible.

A equals 16,200 when volatile combustible equals from 35-40 per cent. of total combustible.

Where Q equals industrial value of coal for steam-making purposes, and where

B equals .64 when fixed carbon equals 82-90 per cent. of total combustible,

B equals .65 when fixed carbon equals 74-82 per cent. of total combustible,

B equals .662 when fixed carbon equals 68.74 per cent. of total combustible,

B equals .551 when fixed carbon equals 50-60 per cent. of total combustible.

In reviewing this formula I may say I was guided in its construction by the fact that the heating value of the volatile combustible is a constantly changing quantity, but remains constant in accordance with its composition of the elements, and that these elements occur in practically fixed proportions, determined by the total volatile combustible matter in the coal. With this formula and the proximate analysis before us, we are readily enabled to determine which of two coals are likely to be the most economical and best suited to the conditions under which combustion must take place, and will, I hope, be found useful by my hearers in enabling them to arrive at the real value of any sample of coal placed before them for their examination and opinion.

In presenting his paper Mr. Thompson said the present mode of determining the efficiency of boilers and furnaces was somewhat crude. We can with a little practice determine the heat-producing value of the coal we are using, but we want to trace that heat. We, as engineers, get the quantity of water that we have evaporated and made into steam, and we call that efficiency, but it does not give us the information that we actually require. We want to know, if there is a loss, where that loss occurs. Let us trace it out in this way : We start by knowing the maximum quantity of heat that the coal will give ; we then collect a sample of our fuel gases and ascertain the composition of them, and from that composition we are enabled to know the exact quantity of air that has been admitted to the furnaces. We are then enabled to determine the exact quantity of carbonic oxide that has been formed during combustion, and if we take and examine our ash and still continue our analysis we are enabled to determine the exact quantity of combustible matter that still remains in the ash, because none of our furnace or grate bars are perfect enough to give nothing but pure ash. We have first the composition of the gases, we have then the quantity of air admitted, we have the heat lost through the formation of carbonic oxide, or heat lost through imperfect combustion.

Mr. Milne : The determination of the heat value in coal is generally done by three methods; first, chemical analysis ; second, by combustion in a coal calorimeter ; and third, by actual burning under the boiler. There is some doubt as to the correctness of chemical analysis. The coal calorimeter is certainly, I think, the most correct method of arriving at it, but if the two experiments are properly conducted—the chemical analysis and the combustion in the coal calorimeter—the results do not vary very much ; but at the same time, when you test a sample of coal, or take a variety of samples from the coal pile and mix them all up and burn them in the coal calorimeter, that does not say the coal that we are going to get for that day is of the same quality, because, although you are getting coal from the same mine, you will get good and bad cars of coal. I do not see, even if we determine the exact value of the heating properties of that sample or set of samples, that it is going to be of very much value to us. There is an instrument—probably my friend Mr. Thompson is acquainted with it ; it is invented by a Mr. Thompson and is used by the North British and some of the leading railways in the Old Country—which I think it might be advisable to describe. It gives you the heating value of coal at once, almost without any calculation. You take a gramme or two grammes of coal, after you have powdered it up, put it in a vessel and put in a certain amount of oxygen, you immerse this little combustion chamber in 966 grammes of water, or double that quantity if you are using two grammes of coal, and if that amount of water is raised one degree Fahrenheit, then that would indicate that we have one pound of water evaporated or boiled off into steam for the raising of the water one degree Fah. If you raise that 10 degrees, it is equivalent to 10 lbs. of water boiled off. If you want to find the thermal value of the coal you are testing you would simply take your 1,934 grammes—that is the amount of water—multiply that by the rise in temperature, and divide by the number of grammes of coal you are burning ; that would give you the exact heat value in the coal. I think that is the simplest method, and it is accurate enough for all practical purposes.

Mr. Thompson said he knew the instrument referred to, but did not consider it reliable. In dealing with so small a quantity of fuel the metal itself absorbed enough heat to lead one astray. He did not say the instrument was useless, but the average engineer is not able to use it. As to the value of a calorimeter, he heard that during last year the Royal Electric Company saved some 6,000 tons of coal, and the Street Railway Company saved a large amount. Now, wouldn't it pay large concerns like those, where they are turning over thousands of dollars' worth of coal every year, to give their engineer the apparatus whereby he could intelligently determine the value of the fuel, and also determine how to use that fuel ? The use of a calorimeter is a delicate operation, and is liable, even with the Thompson calorimeter, to give a great deal of error. He then described his own method as follows : I take a large quantity of coal and grind it up, and so intermix it that I get as nearly an average sample as possible ; then I go to the other side of the pile and make from 15 to 25 analyses and get as nearly as possible a fair average analysis of the coal in question, and it is surprising how these analyses will vary. No intelligent engineer would go and take the best coal he could see ; he would make an effort to get as nearly as possible an average sample, then the making of the proximate analysis becomes an easy matter. They are more liable to get correct results from a chemical analysis than the average engineer is from the use of a Thompson calorimeter.

Mr. Wickens said these ideas were right for a large plant, but the average engineer is not expert enough at such delicate tests to get correct results. A firm burning say $2,000 worth of coal a year, hardly pays enough for an engineer of such ability. The ordinary engineer goes at it in a thumb-handed way, but he is often as near right as the scientific man. He doubted whether there was an expert in one of our colleges who could declare that he was absolutely correct. He finds he has to allow for this and that, and it is partly guess-work.

Mr. Wright said it was nice to be able to determine the exact value of a sample of coal, but before that can be of value to the large coal user it will be necessary to concoct a scheme to compel the mining companies to send in the same kind of coal that we get in the sample.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

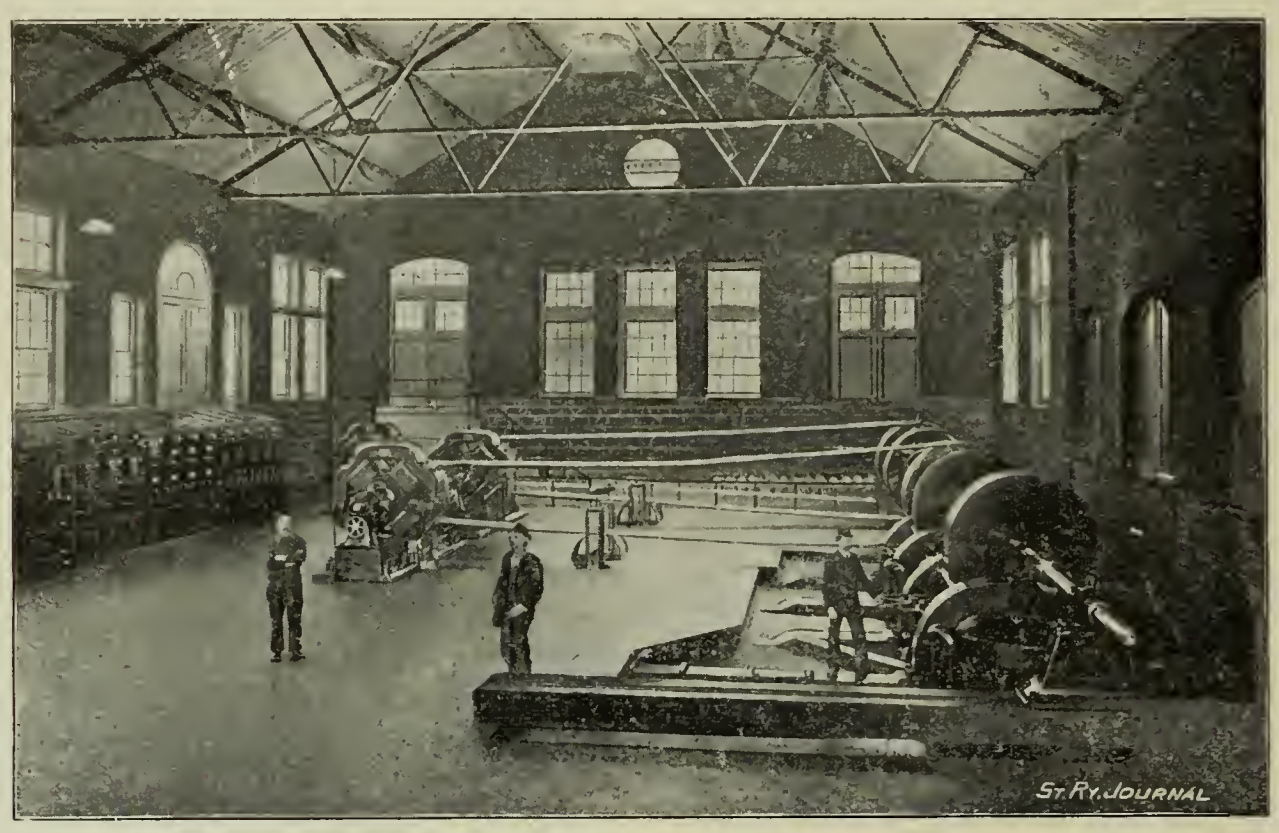
At the convention of the National Electric Light Association at Niagara Falls, N.Y., in June, there were a number of Canadians well-known in electrical circles on both sides of the line. Among them were noticed F. C. Armstrong, Toronto; T. A. Badger, jr., Quebec; E. B. Biggar (The Canadian Engineer); F. A. Bowman, New Glasgow, N.S ; John Carroll, Montreal; Prof. C. A. Carus-Wilson, Mon-

Niagara Falls Park and River Railway Power House.

treal; E. E. Cary, St. Catharines; E. T. Freeman, Halifax, N.S., W. A. Johnson, Toronto; J. A. Kammerer, Toronto; R. S. Kelsch, Montreal; John Langton, Toronto; Frank LeBlond, Niagara Falls, Ont.; E. D. McCormack, Toronto; Charles Morton, Montreal; John Murphy, Ottawa; Frederic Nicholls, Toronto; Geo. A. Powell, St; Catharines, Ont.; J. F. Rothsay, Niagara Falls, Ont.; A. E. Smaill, Montreal; W. McLea Walbank, Montreal; Geo. W. Watts, Toronto.

The president, Frederic Nicholls, to whose most able management of the affairs of the association during his term of office we referred in our last issue, stated in the opening address the reasons for the selection of Niagara Falls as the place of meeting, on account of its pre-eminence as an electrical power distribution centre.

"In this connection, I am of the opinion," said Mr. Nicholls, "that the lecture to be given by L. B. Stillwell will serve as a tidal mark. At the Buffalo convention we occupied ourselves in discussing the possibility or otherwise of transmitting Niagara power to Buffalo; Mr. Stillwell's paper will set forth the various actual appliances of Niagara power at the present time, including transmission to Buffalo, and future presi-



NIAGARA FALLS PARK AND RIVER RAILWAY—INTERIOR OF POWER HOUSE.

dents of this association will, in all probability, refer to his paper and draw comparisons when adverting to the strides which will then have been made in the wider utilization of this mighty power, which for countless ages has been simply running to waste, so far as any economic use is concerned, and apart from its value as the greatest scenic wonder of the world. I fully appreciate the honor of presiding at this meeting, which, for the reasons I have just referred to, will be embodied in the annals of the association as marking an historic epoch in the advancement of the science of electricity as applied to industry and it is therefore with more than ordinary satisfaction that I am authorized to state that at no previous period has this association been as prosperous, shown greater vitality, or commanded such respect. It is now an acknowledged authority on matters electrical, its membership confers a privilege that has more than a sentimental value, and its gathering strength will offer a bar to use of powers municipal or corporate unjustly or arbitrarily directed for the purpose of destroying the capital investment of those who look to it for protection. In union is strength, and to-day our membership numbers more active members than ever before, and the financial statement to be presented in due course by the chairman of the finance committee will show that after making provision for all expenditures necessary to maintain the usefulness of the association, an unusually large credit balance is at your disposal. It is certainly cause for congratulation that increasing prosperity has been followed by an access of dignity and influence, and the more recent meetings have been remarkable for the greater interest that has been taken in the actual work of the association, and the lesser attention that has been given to the merely social and entertainment features of the programme. At this meeting, although offers of entertainments and privileges had been numerous, only those from electrical concerns had been accepted, it being felt that this was more purely a business meeting, held for the furtherance of the immediate objects of the association." In conclusion, President Nicholls said that the asso-

NIAGARA FALLS PARK AND RIVER RAILWAY—BRIDGE AT DUFFERIN ISLAND.

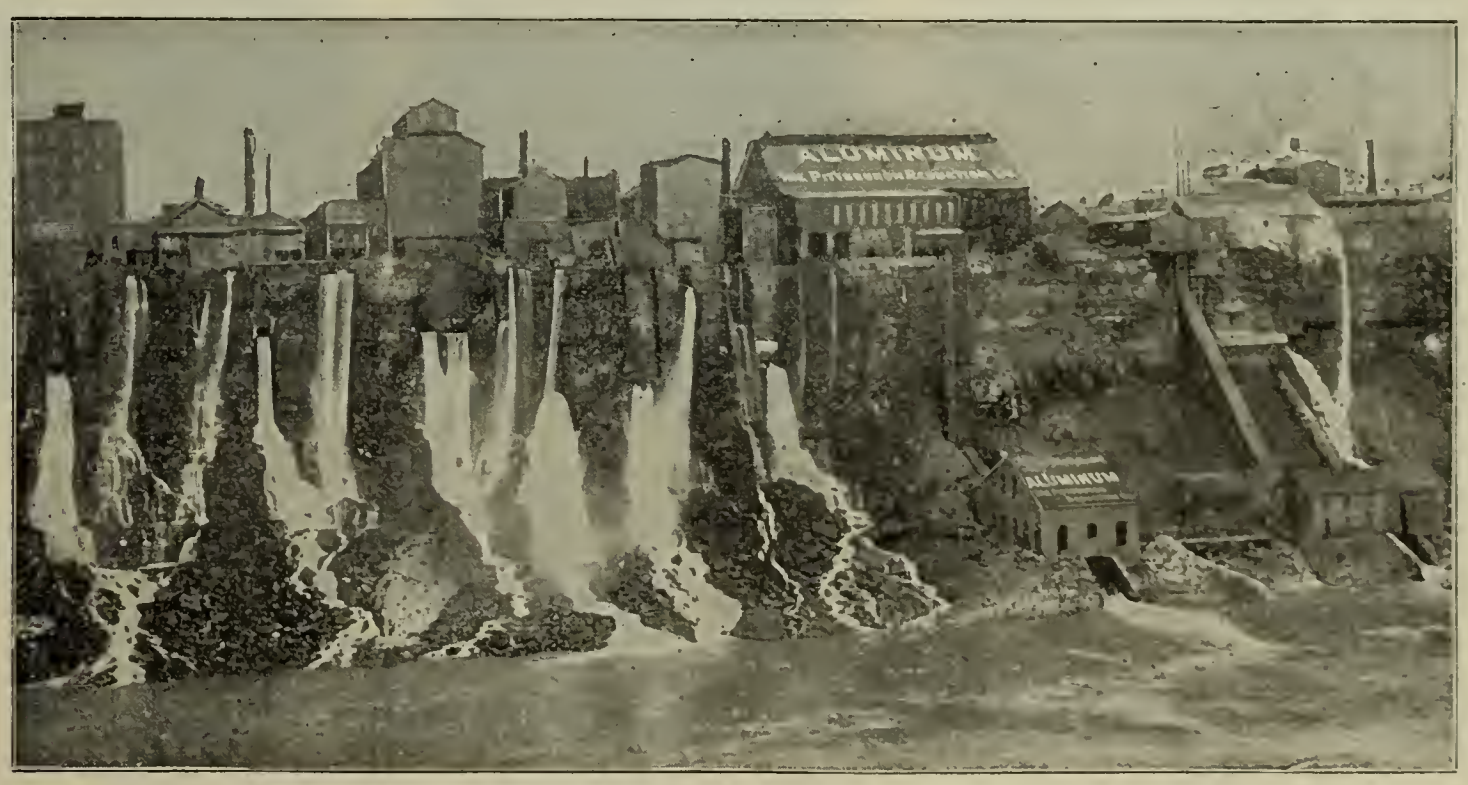
ciation and the electrical profession owed a deep debt of gratitude to the electrical press, and that the importance of its labors in behalf of electrical industries could hardly be over-estimated.

The Committee on Data made its report through H. M. Swetland, its chairman. It embodies the results obtained by an engineering expert engaged for this purpose, but covers only fourteen plants. The majority of station managers object to the publication of their data, hence the restricted ground of the report. The report of the Finance Committee showed that the association possessed net assets of $52,572.23, of which $1,385.94 consisted of cash, and that there was no indebtedness.

J. B. Cahoon, Elmira, N.Y., read a paper on "The Establishment of a Base Price for Current," which dealt chiefly with the lack of knowledge of the cost of incandescent lights, and the difference between charges for these lights and arcs. He thought the variation in cost between place and place should be largely based on the price of coal. The Committee on Wiring brought in a code which it was hoped would unite the interests of those who are insured and those who do the work in the adoption of a common standard code. The code was adopted.

J. G. White, in his paper on "The Niagara Power Transmission Line," included an interesting review of the history and an account of the construction of the line, and the reasons adopted for the various specific modifications in the usual design of power transmission lines adopted in this instance. At its conclusion Mr. White explained that it was perfectly practicable to replace insulators on the line without shutting off the current. This has been done by the use of a large insulated stool, on which a ladder is placed, or by handling the wire with an insulator mounted on the top of a pole, which is forced up under it, thus lifting it up off of the pin insulator and permitting the ladder to be replaced. With current of 10,000 volts the capacity of a man is sufficient to cause a flow of current which will give him a considerable shock, and a nervous man might be knocked off the ladder by this. The consequence is that replacing insulators is neither a very safe nor a very pleasant task. The lightning arrester problem is still in process of solution, and is largely in the experimental stage. The line is protected by barbed fence wires, which are run on top of the poles and on the outer end of the cross-arms, in a little fork at the top of an iron pin stuck through the end of the arm. At every fifth pole these fence wires are grounded with a number six copper wire running to a coil at the bottom of the pole.

PICTURESQUE NIAGARA—THE CANADIAN SIDE.



INDUSTRIAL NIAGARA—THE AMERICAN SIDE.

Arthur Wright, of Brighton, England, read a summary of his paper on "Profitable Extension of Electricity Supply Stations." This was an interesting thesis upon the desirability of domestic lighting and of certain other forms of custom which can be secured by the use of more equitable systems of charging for current. The author contended that the only available method is the sliding scale of hours of consumption. This paper was followed by a long discussion. Mr.

Wright, in replying to a number of questions, gave the practical details of the operation of his system in Brighton ; the instruments used sum up the consumer's bills without the necessity for any calculation, and could be read by an ordinary meter reader. In reply to further questions Mr. Wright stated that the maximum demand was measured by a recording ammeter, which is used during the four winter months, and its maximum for that time taken as the maximum demand.

At the closing session of the convention Lieut. F. Jarvis Patten, of New York, presented his paper on "Frequency Transformation," and C. F. Scott, of Pittsburg, read his paper on "Rotaries for Transforming Alternating into Direct Current." The report of the committee on Standard Candle Power of Incandescent Lamps was also presented by James I. Ayer, Dr. Louis Bell, the chairman of the committee, not being present. This report will be found in another column.

The officers which were elected to preside over the destinies of the association during the coming year were : Samuel Insull, of Chicago, president : A. M. Young, of Waterbury, Conn., first vice-president ; George R. Stetson, New Bedford, Mass , second vice-president. The following were chosen as members of the executive committee : Frederick Gilbert, Boston ; W. Worth Bean, St. Joseph, Mich. ; Mr. Stevens, Elizabeth, N.J. ; W. McLea Walbank, Montreal.

The views of Niagara Falls and its neighborhood on both sides of the river, which we give in connection with this report of the National Electric Light Association, were crowded out of our report of the Canadian Electrical Association's meeting in our July number.

CANADIAN ASSOCIATION STATIONARY ENGINEERS.

We report the results of the annual election in the different branches C.A.S.E., in addition to those which appeared in the July number of THE CANADIAN ENGINEER, as follows :

Hamilton—Wm. Norris, president ; G. Mackie, vice-president ; Joseph Ironside, recording secretary, Markland street.

Stratford--John Hoy, president ; Samuel H. Weir, secretary.

Brantford—J. B. Forsyth, president ; Joseph Ogle, vice-president ; T. Pilgrim, Continental Cordage Company, secretary.

London—D. G. Campbell, president ; B. Bright, vice-president ; W. Blythe, secretary.

Guelph—H. Geary, president ; Thos. Anderson, vice-president ; H. Flewelling, recording secretary ; P. Ryan, financial secretary ; C. F. Jordan, treasurer.

Ottawa—Frank Robert, president ; T. G. Johnson, secretary.

Peterborough—W. L. Outhwaite, president ; W. Forster, vice-president ; A. McCallum, secretary.

Brockville—Archibald Franklin, president ; John Grundy, vice-president ; James Aikins, recording secretary.

Carleton Place Branch No. 16—Joseph McKay, president ; J D.Armstrong, secretary.

Kincardine—Daniel Bennett, president ; Joseph Lighthall, vice-president ; Percy C. Walker, secretary, waterworks.

Dresden—Thos. Steeper, secretary.

Berlin—J. R. Utley, president ; G. Steinmetz, vice-president ; secretary and treasurer, W. J. Rhodes, Berlin, Ont.

St. Laurent—R. Drouin, president ; Alfred Latour, secretary, 306 Delisle street, St. Cunegonde.

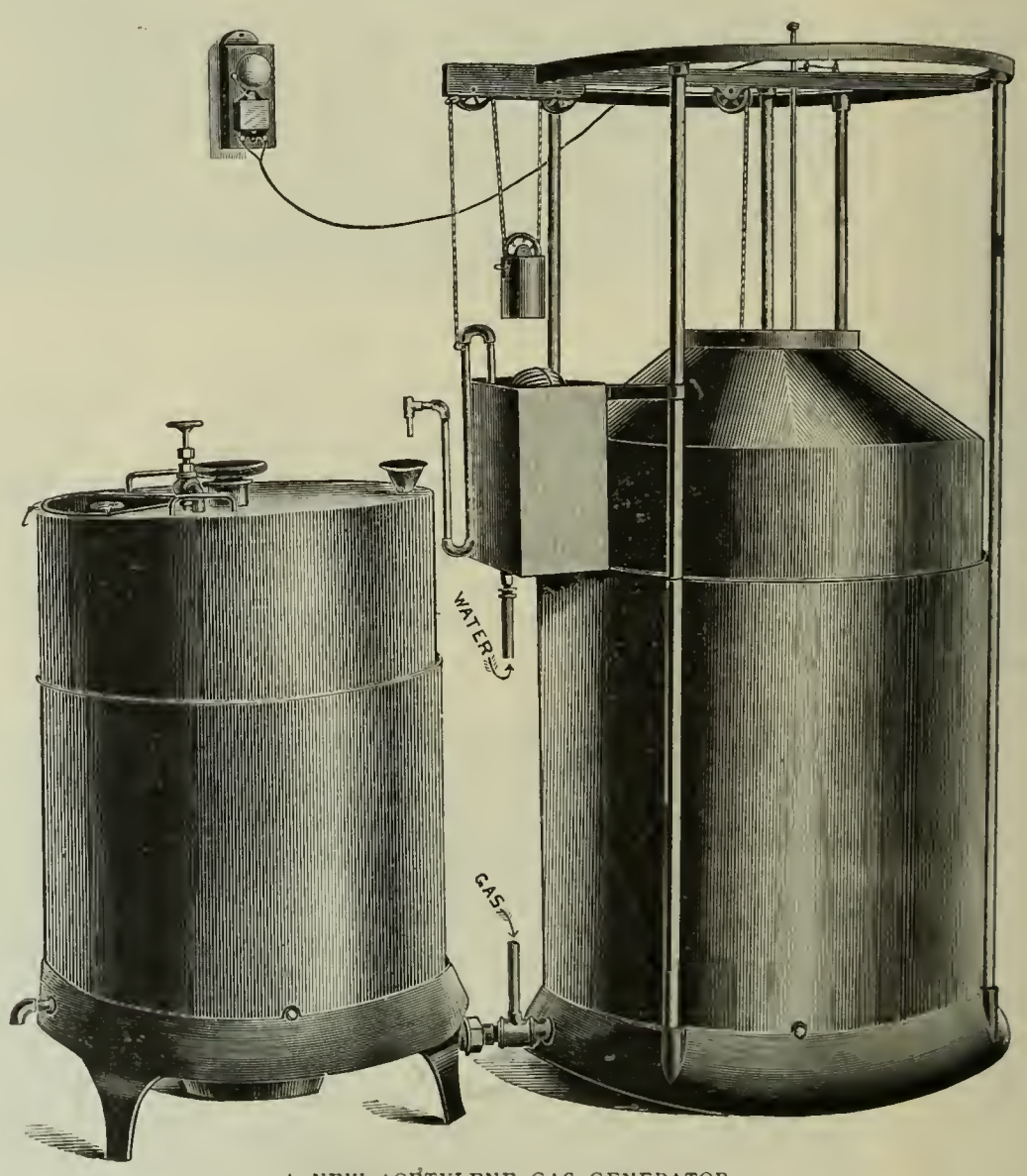
Brandon, Man., Branch No. 1.—A. R Crawford, president ; Arthur Fleming, secretary.

Winnipeg—G. M. Hazlett, President: J. Sutherland, rec. secretary ; A. B. Jones, financial secretary.

A NEW ACETYLENE GAS GENERATOR.

The success of any acetylene gas generating apparatus depends largely on the regulation of its water supply to the carbide. In the machine here illustrated, the device for this purpose can be said to be both old and new; old, in being a syphon, the common principle of which has been known for ages; new, in its ingenious arrangement whereby the discharging end of the syphon can be raised above its source of supply, thereby arresting its operation without causing the water in it to "break" and run back to the supply tank, as would occur in doing this with the old simple form of syphon ; yet it has no valves or obstructions contained within it, simply a crooked piece of pipe. The secret of its operation is contained in the crook; it will be observed that the water must enter that end of the syphon immersed in the tank and pass up over the edge of the tank, then down again to near the bottom of the tank, where it again takes an upward turn, its end terminating in a spout about on a level with the top of the tank. The "U" shaped bend on the outside of the tank serves to contain sufficient water to more than counterbalance that of the column in the pipe within the tank ; hence, when the discharging end of the syphon is raised above the water in the tank the lower part of the syphon outside the tank is still below it. If the discharging end of the syphon be lowered slightly below the surface of the water in the tank, water starts to run, increasing in volume as the syphon is lowered ; thus a simple and efficient means is provided for regulating the supply of water, a drop or a stream being furnished as required, depending on the number of lights in use.

The illustration shows the machine in its working position, the gasometer top being at a height just sufficient to stop the flow of water from the syphon, the discharging end of which is shown as just above the water in the small tank to which it is connected ; a slight lowering of the gasometer dome pulls downward on the chain, which is attached to the gasometer



A NEW ACETYLENE GAS GENERATOR.

dome, and which passes over pulleys to the syphon. As the dome descends the chain is drawn around the pulleys in the weight until a small obstruction, on the chain, reaches the weight, when the latter is lifted entirely by that part of the chain below the weight, and the gasometer dome. This takes the tension from that part of the chain going to the syphon, when the latter lowers from its own weight, till its discharging end becomes lower than the water in the supply tank; water then flows from the syphon to the carbide in the generator, gas is generated, which passes to the gasometer, and the dome of the latter raises again till the obstruction on the chain passes from the weight, when the latter, exerting its weight equally on both ends of the chain, overcomes the weight of the syphon, causing it to raise till the discharging end is again above the water in the tank. The syphon is prevented from raising too high by an obstruction on the chain, which comes in contact with the pulley over which the chain passes, just above the syphon. The dome of the gasometer is guided up and down by a central rod extending from the frame above, down through a tube in the gasometer dome ; the lower end of the rod is

secured in a socket in the bottom of the gasometer. The tube through which the rod passes serves to prevent the escape of gas from the gasometer, as its lower end reaches into the water in the gasometer sufficiently to prevent this, the tube also serving to hold the dome in position. Experience has shown this to be the simplest and best method of guiding the dome without effecting the pressure of gas in the gasometer or the steadiness of the lights in the slightest degree.

The desirability of some simple means for preventing the accumulation of more gas in the machine, from any reason whatever, than it can safely contain, and which will prevent the pressure of the gas from increasing its normal condition, is conceded not only to be a distinct advantage to the machine itself, but an absolute necessity. This feature of an acetylene gas machine is like the safety valve on a steam boiler; it is placed there, not for the purpose of using it, but to prevent an accident by interference with the working of the machine, either by design or otherwise. To accomplish this desirable object, a large tube, six or eight inches, is connected to the dome of the gasometer and reaches down to within a few inches of the bottom of the dome, passing up through the bottom of the gasometer, and slightly above the water therein, and within the tube referred to is an overflow pipe, the outer end of which can be carried without the building if desired. In operation, should the dome of the gasometer ascend sufficiently to cause the suspended tube to be raised out of the water in the gasometer, the gas would pass within said tube, where it would enter the overflow pipe, and be carried to the outside of the building. When the gasometer dome again descends the tube enters the water, inclosing within it the overflow pipe, which prevents any further escape of gas. It will therefore be readily seen that a simple and sure means is provided for the protection of the machine, and the prevention of the escape of gas within the building. It will also be readily understood that this arrangement does not operate by friction, or in any way vary the pressure of gas.

An appreciable improvement, has, it is claimed, been made in the construction of the gasometer. By reference to the engraving it will be seen that the upper part of the generator slides within the lower part, double walls in the lower part being provided for, the space between the two walls into which the upper part of the generator slides is filled with a liquid, which provides an effective seal to prevent the escape of gas. Within the generator is a round table, which turns on a shaft that extends through a liquid seal to the top of the generator. This table has a rim around it, several inches deep; within the table is secured four cells, separated from each other about half an inch, the space between them and within the rim of the table being filled with an inexpensive liquid, whose presence does not cause moisture, hence no gas is generated. Suspended from the top of the generator, at a position just above one of the cells, is a tube, open at both ends and slightly larger than the cells, in the table. The top of this tube is closed by a liquid sealing cover, which enters double walls. In the top of the generator beneath the discharging end of the syphon, is seen the funnel-shaped opening, into which water passes, to reach the carbide, which is placed in cans, and set within the cells on the table. To operate the generator, the top is pressed down as far as it will go. This causes the tube connected with the generator to surround one of the cells which is directly beneath it. The tube entering the liquid surrounding the cell, completely isolates the cell from the remainder of the generator. The cover over the top of the tube, now being removed, the can within the cell and containing the spent carbide, is exposed, the escape of gas from the generator being prevented by the lower end of the tube being immersed in the liquid in the table. To replenish the supply of carbide, the can containing the spent carbide is removed, and a fresh can set within the cell. The cover is then replaced and the catch which held the top down, released, when the top of the generator raises of itself by the pressure of the gas in the gasometer, which passes into the generator, as its top continues to raise, this gas having originally passed from the generator to the gasometer when the top of the former was pressed down and the gasometer dome rose to accommodate it. When it is necessary to replenish another cell, the table is turned by grasping a wheel on the top of the generator, and giving it a quarter turn, its correct position being indicated by a rib on the base of the table engaging in a slot on the bearing, on which the table turns. It will thus be seen that the spent carbide can be removed and the supply replenished while the machine is in operation without the escape of gas and without soiling the hands, the whole operation requiring less than two minutes time.

As the odor from acetylene gas is decidedly objectionable, it will thus be seen what desirable features this apparatus contains, in not permitting the escape of gas at any time, within the house or other building within which it is kept. The exhaustion of the cells is indicated by an electric bell connected by wires to the gasometer, and located any desirable place within the building. When the alarm is given it is only necessary to turn the wheel on the top of the generator one quarter of a revolution. This turns the table in a like manner, and places a fresh cell of carbide beneath the water feed. The operation requires but a moment's time.

From this extended description it must not be inferred that the machine is complicated, having respect to what the machine accomplishes. It is quite the reverse. The machine here illustrated is capable of sustaining from fifty to a hundred lights. A machine suitable for lighting residences where but ten to twelve lights are required is made in a modified form, the gasometer and generator being constructed together, so that little space is occupied. Arrangements for the manufacture and sale of this invention will be made at once. Those interested in acetylene gas lighting may communicate with Messrs. Kerr & Fry, of Niagara Falls, Canada, who at present control the patents.

SIR SANFORD FLEMING.

Sanford Fleming, K.C.M.G., LL.D., C.E., Ottawa, is the most prominent and original of Canadian civil engineers. He was born at Kirkcaldy, Fifeshire, Scotland, January 7th, 1827. He received his early education near his birthplace, and came to Canada at the age of eighteen. He was on the engineering staff of the Northern Railway from 1852-1863, the latter half of service being as chief engineer. In 1863 he was sent as delegate to the Imperial Government in reference to a railway from the Provinces of Canada to British Columbia. He was appointed in 1863 by Governments of Canada, New Brunswick and Nova Scotia, and by the Imperial Government, chief engineer of the Intercolonial Railway. In 1871 he was made engineer-in-chief of the Canada Pacific Railway. When the construction of the C P R. was well advanced, political questions arose, and in 1880 he resigned—and though he was not thereafter concerned in the construction of the work, no one has sought to take away from him the reputation of the pioneer engineer of Canada, and the country's benefactor. On his retirement in 1880, he was elected Chancellor of Queen's University, re-elected 1883 1886, 1889 and 1892. In 1884 he received the honorary degree of LL.D., from St. Andrew's University, Scotland. In 1881 he went as delegate from the Canadian Institute and Meteorological Society to the International Geographical Congress, at Venice, and in 1884 he was appointed delegate of Great Britain to represent the Dominion at the International Prime Meridian Conference at Washington. Mr. Fleming was engineer of the Hoosac tunnel, the greatest achievement of its kind at the time of its construction. Mr. Fleming has been a contributor to various scientific and other publications, and has been a mover in the "time reform" and Pacific cable movements. Mr. Fleming married in 1855 Miss Hall, daughter of Sheriff Hall, Peterboro', Ont. On the occasion of the Queen's Diamond Jubilee, no honors were more worthily bestowed than that of knighthood conferred on Sir Sanford Fleming.

THE NEW METAL TARIFF.*

The following is the new Canadian tariff, as now officially proclaimed, affecting the iron and other metal trades, and including building material :

EARTHENWARE, CEMENTS, SLATE AND STONEWARE.

Building brick. paving brick, stove linings, and fire brick, n.e.s., and manufactures of clay or cement, n.o.p., 20 per cent. ad valorem.

Earthenware and stoneware, viz.: demijohns, churns or crocks, 30 per cent. ad valorem.

Drain tiles, not glazed, 20 per cent. ad valorem.

Drain pipes, sewer pipes, chimney linings, or vents, chimney tops and inverted blocks, glazed or unglazed, and earthenware tiles, 35 per cent. ad valorem.

China and porcelain ware, also earthenware and stoneware, brown or colored and Rockingham ware, white granite or iron stoneware, "c.c." or cream-colored ware, decorated, printed or sponged, and all earthenware, n.e.s., 30 per cent. ad valorem.

Baths, tubs and wash-stands of earthenware, stone, cement, or clay, or of other material, n.o.p., 30 per cent. ad valorem.

Cement, Portland and hydraulic or water lime, in bags, barrels or casks, the weight of the package to be included in weight for duty, 12½ cents. per one hundred pounds.

Plaster of Paris, or gypsum, ground, not calcined, 15 per cent. ad valorem.

Plaster of Paris, or gypsum, calcined or manufactured, the weight of the package to be included in the weight for duty, 12½ cents per one hundred pounds.

Lithographic stones, not engraved, 20 per cent. ad valorem.

Grindstones, not mounted, and not less than 36 inches in diameter, 15 per cent. ad valorem.

Grindstones, n.e.s., 25 per cent. ad valorem.

Flagstones, sandstone and all building stone, not hammered or chiselled ; and marble and granite, rough, not hammered or chiselled, 15 per cent. ad valorem.

Marble and granite, sawn only ; flagstone and all other building stone, dressed ; and paving blocks of stone, 20 per cent. ad valorem.

Marble and granite, n.e.s., and all manufactures of marble or granite, n.o.p., 35 per cent. ad valorem.

Manufactures of stone n.o.p., 35 per cent. ad valorem.

Roofing slate, 25 per cent. ad valorem ; provided that the duty shall not exceed 75 cents per square.

Slate mantels and other manufactures of slate, n.es., 30 per cent. ad valorem.

Slate pencils and school writing slates, 25 per cent. ad valorem.

Mosaic flooring of any material, 30 per cent. ad valorem.

METALS AND MANUFACTURES OF

Iron or steel scrap, wrought, being waste or refuse, including punchings, cuttings of clippings of iron or steel plates or sheets having been in actual use; crop ends of tin plate bars, or of blooms, or of rails, the same not having been in actual use, one dollar per ton.

Nothing shall be deemed scrap iron or scrap steel except waste or refuse iron or steel fit only to be re-manufactured in rolling mills.

Iron in pigs, iron kentledge, and cast scrap iron, two dollars and fifty cents per ton.

Ferro-silicon, ferro-manganese, and spiegeleisen, 5 per cent. ad valorem.

Iron or steel ingots, cogged ingots, blooms, slabs, billets, puddled bars and loops or other forms, n.o.p., less finished than iron or steel bars, but more advanced than pig iron, except castings, two dollars per ton.

Rolled iron or steel angles, tees, beams, channels, girders and other rolled shapes or sections, weighing less than 35 pounds per lineal yard, not punched, drilled or further manufactured than rolled, n.o.p., seven dollars per ton.

Rolled iron or steel angles, tees, beams, channels, joists, girders, zees, stars, or other rolled shapes, or trough, bridge, building or structural rolled sections or shapes, not punched, drilled or further manufactured than rolled, n.e.s., and flat eye-bar blanks not punched or drilled, 10 per cent. ad valorem.

Bar iron or steel, rolled, whether in coils, rods, bars or bundles, comprising rounds, ovals and squares, and flats ; and rolled shapes, n.o.p.; and rolled iron or steel hoop, band, scroll or strip, eight inches or less in width, number eighteen gauge and thicker, n.e.s., seven dollars per ton.

Universal mill or rolled edge bridge plates of steel when imported by manufacturers of bridges, 10 per cent. ad valorem.

Rolled iron or steel plates not less than thirty inches in width, and not less than one-quarter of an inch in thickness, n.o.p., 10 per cent. ad valorem.

Rolled iron or steel sheets or plates, sheared or unsheared, and skelp iron or steel, sheared or rolled in grooves, n.e.s., seven dollars per ton.

Skelp iron or steel, sheared or rolled in grooves, when imported by manufacturers of wrought iron or steel pipe for use only in the manufacture of wrought iron or steel pipe in their own factories, 5 per cent. ad valorem.

Rolled iron or steel sheets number seventeen gauge, and thinner, n.o.p.; Canada plates ; Russia iron ; flat galvanized iron or steel sheets, terne plate, and rolled sheets of iron or steel coated with zinc, spelter or other metal, of all widths or thickness, n.o.p., and rolled iron or steel hoops, band, scroll or strip, thinner than number eighteen gauge, n.e.s., 5 per cent. ad valorem.

Chrome steel, 15 per cent. ad valorem.

Steel, in bars, bands, hoops, scroll or strips, sheets or plates, of any size, thickness or width, when of greater than two and one-half cents per pound, n.o.p., 5 per cent, ad valorem.

Swedish rolled iron and Swedish rolled steel nail rods under half an inch in diameter for the manufacture of horse-shoe nails, 15 per cent. ad valorem.

Iron and steel railway bars or rails of any form, punched or not, n.e.s., for railways, which term for the purpose of this item shall include all kinds of railways, street railways and tramways, even although they are used for private purposes only, and even although they are not used or intended to be used in connection with the business of common carrying of goods or passengers, 30 per cent ad valorem.

Railway fish plates and tie plates, eight dollars per ton.

Switches, frogs, crossings and intersections for railways, 30 per cent. ad valorem.

Locomotives for railways, n.e.s., 35 per cent. ad valorem.

Iron or steel bridges, or parts thereof ; iron or steel structural work, columns, shapes or sections, drilled, punched or in any further stage of manufacture than as rolled or cast, n.e.s., 35 per cent. ad valorem.

Forgings of iron or steel of whatever shape or size or in whatever stage of manufacture, n.e.s.; and steel shafting turned, compressed, or polished ; hammered iron or steel bars or shapes, n.o.p., 30 per cent. ad valorem.

Iron or steel castings, in the rough, n.e.s., 25 per cent. ad valorem.

Stove plates, stoves of all kinds, for oil, gas, coal or wood, or parts thereof, and sad or smoothing, hatters' and tailors' irons, plated wholly or in part, or not, 25 per cent. ad valorem.

Spring axles, axle bars, n.e.s., and axle blanks, and parts thereof, of iron or steel, for railway or tramway, or other vehicles, 35 per cent. ad valorem.

Cart or wagon skeins or boxes, 30 per cent. ad valorem.

Cast iron pipe of every description, eight dollars per ton.

Wrought iron or steel boiler tubes, n.e.s., including flues and corrugated tubes for marine boilers, 5 per cent. ad valorem.

Tubes of rolled steel, seamless, not joined or welded, not more than one and one-half inch in diameter ; and seamless steel tubes for bicycles, 10 per cent. ad valorem.

Wrought iron or steel tubing, plain or galvanized, threaded and coupled or not, over two inches in diameter, n.e.s., 15 per cent. ad valorem.

Wrought iron or steel tubing, plain or galvanized, threaded and coupled or not, two inches or less in diameter, n.e.s., 35 per cent. ad valorem.

Other iron or steel pipe or tubing, plain or galvanized, riveted, corrugated or otherwise specially manufactured, n.o.p., 30 per cent. ad valorem.

Iron or steel fittings for iron or steel pipe, of every description, and chilled iron or steel rolls, 30 per cent. ad valorem.

Iron or steel cut-nails or spikes (ordinary builders') ; and railroad spikes, one-half of one cent per pound

*The expression "gauge," when applied to metal sheets or plates or to wire, means the thickness as determined by Stubb's standard gauge ; the expression "in diameter," when applied to tubing, means the actual inside diameter; the expression "sheet," when applied to metals, means a sheet or plate not exceeding three-sixteenths of an inch in thickness; the expression "plate," when applied to metals, means a plate or sheet more than three-sixteenths of an inch in thickness

Wrought and pressed nails and spikes, trunk, clout, coopers', cigar box, Hungarian, horse-shoes, and other nails, n.e.s., horse, mule and ox shoes, 30 per cent. ad valorem.

Wire nails of all kinds, n.o.p., three-fifths of one cent per pound.

Composition nails and spikes and sheathing nails, 15 per cent. ad valorem.

Iron or steel shoe tacks, and ordinary cut tacks, feathered or not, brads, sprigs and shoe nails, double pointed tacks, and other tacks of iron and steel, n.o.p., 35 per cent. ad valorem.

Screws, commonly called "wood screws," of iron or steel, brass or other metals, including lag or coach screws, plated or not, and machine or other screws, n.o.p., 35 per cent. ad valorem.

Coil chain, coil chain links, and chain shackles, of iron or steel, five-sixteenths of an inch in diameter and over, 5 per cent. ad valorem.

Barbed wire, and galvanized wire for fencing, numbers nine, twelve and thirteen gauge, 15 per cent. ad valorem, until 1st January, 1898; thereafter free.

Buckthorn strip fencing, woven wire fencing, and wire fencing, of iron or steel, n.e.s., 15 per cent. ad valorem.

Wire, single or several, covered with cotton, linen, silk, rubber or other material, including cable so covered, n.e.s., 30 per cent. ad valorem.

Brass wire, plain, 10 per cent. ad valorem.

Copper wire, plain, tinned or plated, 15 per cent. ad valorem.

Wire cloth, or woven wire of brass or copper, 25 per cent. ad valorem.

Wire of all metals and kinds, n.o.p., 20 per cent. ad valorem.

Wire rope, stranded or twisted wire, clothes line, picture or other wire, and wire cable, n.e.s., 25 per cent. ad valorem.

Wire cloth or wove wire, and wire netting, of iron or steel, 30 per cent. ad valorem.

Needles, of any material or kind, and pins manufactured from wire of any metal, n.o.p., 30 per cent. ad valorem.

Lead, old, scrap, pig and block, 15 per cent. ad valorem.

Lead, in bars, and in sheets, 25 per cent. ad valorem.

Lead pipe, lead shot and lead bullets, 35 per cent. ad valorem.

Lead, manufactures of, n.op., 30 per cent. ad valorem.

Brass and copper nails, tacks, rivets and burrs or washers; bells and gongs, n.e.s., and all manufactures of brass or copper, n.o.p., 30 per cent. ad valorem.

Zinc, manufactures of, n.o.p., 25 per cent. ad valorem.

Nickel anodes, 10 per cent. ad valorem.

Iron or steel nuts, washers, rivets, and bolts, with or without threads, and nut, bolt and hinge blanks, and T and strap hinges of all kinds, n.e.s., three-quarters of one cent per pound and 25 per cent. ad valorem.

Builders', cabinet-makers', upholsterers', harness-makers', saddlers', and carriage hardware, including butt-hinges, locks, curry-combs or curry-cards, horse-boots, harness and saddlery, n.e.s., 30 per cent. ad valorem.

Skates of all kinds, roller or other, and parts thereof, 35 per cent. ad valorem.

Gas meters, 35 per cent. ad valorem.

Safes, doors for safes and vaults; scales, balances, weighing beams, and strength testing machines of all kinds, 30 per cent. ad valorem.

Carvers, knives and forks of steel, butcher and table steels, oyster, bread, kitchen, cooks', butcher, shoe, farrier, putty, hacking and glaziers' knives, cigar knives, spatulas or palette knives, razors, erasers or office knives, pen, pocket, pruning, sportsmen's or hunters' knives, manicure files, scissors, trimmers; barbers', tailors', and lamp shears, horse and toilet clippers, and all like cutlery, plated or not, n.o.p. When any of the above articles are imported in cases or cabinets, the cases or cabinets shall be dutiable at the same rate as their contents—30 per cent. ad valorem.

Knife blades or blanks, and table forks of iron or steel in the rough, not handled, filed, ground or otherwise manufactured, 10 per cent. ad valorem.

Celluloid, moulded into sizes for handles of knives and forks, not bored nor otherwise manufactured: also, moulded celluloid balls and cylinders, coated with tin-foil or not, but not finished or further manufactured, and celluloid lamp shade blanks, 10 per cent. ad valorem.

Bird, parrot, squirrel and rat cages, of wire, and metal parts thereof, 35 per cent. ad valorem.

Files and rasps, n.e.s., 30 per cent, ad valorem.

Adzes, cleavers, hatchets, saws, wedges, sledges, hammers, crow-bars, cant-dogs and track tools; picks, mattocks, and eyes or poles for the same; anvils, vises; and tools, of all kinds, for hand or for machine use, including shoemakers' and tinsmiths' tools or bench machines, n.o.p., 30 per cent ad valorem.

Axes, scythes, sickles or reaping hooks, hay or straw knives, edging knives, hoes, rakes, pronged forks, snaths, farm road or field rollers, post-hole diggers, and other agricultural implements, n.e.s., 25 per cent. ad valorem.

Shovels and spades, iron or steel, n.e.s.; shovel and spade blanks, and iron or steel cut to shape for the same; and lawn mowers, 35 per cent. ad valorem.

Britannia metal, nickel silver, Nevada and German silver, manufactures of, not plated, and manufactures of aluminum, n.o.p. 25 per cent. ad valorem.

Sterling or other silverware, nickel-plated ware, gilt or electro-plated ware, wholly or in part, of all kinds, n.e.s., 30 per cent. ad valorem.

Telephone and telegraph instruments, electric and galvanic batteries, electric motors, dynamos, generators, sockets, insulators of all kinds; and electric apparatus, n.e.s., 25 per cent ad valorem.

Electric light carbons and carbon points, of all kinds, n.e.s., 35 per cent. ad valorem.

Carbons over six inches in circumference, 15 per cent. ad valorem.

Lamps, side-lights and head-lights, lanterns, chandeliers, gas, coal or other oil fixtures and electric light fixtures, or metal parts thereof, including lava or other tips, burners, collars, galleries, shades and shade-holders, 30 per cent. ad valorem.

Lamp springs, and glass bulbs for electric lights, 10 per cent. ad valorem.

Babbitt metal, type metal, phosphor tin and phosphor bronze in blocks, bars, plates, sheets and wire, 10 per cent. ad valorem.

Type for printing, including chases, quoins and slugs, of all kinds, 20 per cent. ad valorem.

Plates engraved on wood, steel, or other metal, and transfers taken from the same, including engravers' plates of steel, polished, engraved or for engraving thereupon, 20 per cent. ad valorem.

Stereotypes, electrotypes, and celluloids for almanacs, calendars, illustrated pamphlets, newspaper advertisements or engravings, and all other like work for commercial, trade or other purposes, n.e.s., and matrices or copper shells for the same, one and one-half cent. per square inch.

Stereotypes, electrotypes and celluloids of newspaper columns, and bases for the same, composed wholly or partially of metal or celluloid, one-fourth of one cent per square inch.

And matrices or copper shells for the same, one and one-half cents per square inch.

Clothes wringers for domestic use, and parts thereof, 35 per cent. ad valorem.

Buckles of iron, steel, brass or copper, of all kinds, n.o.p., (not being jewellery), 30 per cent. ad valorem.

Guns, rifles, including air guns and air rifles, not being toys, muskets, cannons, pistols, revolvers, or other firearms: cartridge cases, cartridges, primers, percussion caps, wads, or other ammunition, n.o.p.; bayonets, swords, fencing foils and masks; gun or pistol covers or cases, game bags, loading tools and cartridge belts, of any material, 30 per cent. ad valorem.

Agate, granite or enamelled iron or steel hollow-ware, 35 per cent. ad valorem.

Enamelled iron or steel ware, n.e.s.: iron or steel hollow-ware, plain black, tinned or coated; and nickel and aluminum kitchen or household hollow-ware, n.e.s., 30 per cent. ad valorem.

Tinware, plain, japanned, or lithographed, and all manufactures of tin, n.e.s., and manufactures of galvanized sheet iron or of galvanized sheet steel, n.o.p., 25 per cent. ad valorem.

Signs, of any material, framed or not; and letters of any material for signs or similar use, 30 per cent. ad valorem.

Fire engines and fire extinguishing machines, including sprinklers for fire protection, 35 per cent. ad valorem.

Brass pumps of all kinds, and garden or lawn sprinklers, 30 per cent. ad valorem.

Printing presses, printing machines, lithographic presses and type-making accessories therefor ; folding machines, book-binders' book-binding, ruling, embossing and paper cutting machines, and parts thereof, 10 per cent, ad valorem.

Sewing machines, and parts thereof, 30 per cent. ad valorem.

Steam engines, boilers, ore crushers and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, cranes, derricks, percussion coal cutters, pumps, n.e.s., windmills, horse-powers, portable engines, threshers, separators, fodder or feed cutters, potato diggers, grain crushers, fanning mills, hay tedders, farm wagons, slot machines and type-writers, and all machinery composed wholly or in part of iron or steel, n.o.p., 25 per cent. ad valorem.

Machine card clothing, 25 per cent. ad valorem.

Mould boards or shaves, or plough plates, land sides, and other plates for agricultural implements, when cut to shape from rolled plates of steel, but not moulded, punched, polished or otherwise manufactured, 5 per cent. ad valorem.

Mowing machines, harvesters, self-binding or without binders, binding attachments, reapers, cultivators, ploughs, harrows, horse-rakes, seed drills, manure spreaders, weeders, and malleable sprocket or link belting chain for binders, 20 per cent. ad valorem.

Trawls, trawling spoons, fly hooks, sinkers, swivels, and sportsmen's fishing bait, and fish hooks, n.e.s., 30 per cent. ad valorem.

Patterns of brass, steel, or other metals (not being models). 30 per cent. ad valorem.

Manufactures, articles or wares not specially enumerated or provided for, composed wholly or in part of iron or steel, and whether wholly or partly manufactured, 30 per cent. ad valorem.

VEHICLES.

Freight wagons, drays, sleighs, and similar vehicles, 25 per cent. ad valorem.

Buggies, carriages, pleasure carts and similar vehicles, n.e.s., including cutters, children's carriages and sleds, and finished parts thereof, n.o.p., 35 per cent. ad valorem.

Railway cars (or other cars), wheel-barrows, trucks, road or railway scrapers and hand-carts, 30 per cent. ad valorem.

Bicycles and tricycles, 30 per cent. ad valorem.

MINERALS.

Asbestos in any form other than crude, and all manufactures thereof, 25 per cent. ad valorem.

Plumbago, not ground or otherwise manufactured, 10 per cent. ad valorem.

Plumbago, ground, and manufactures of, n.e.s., and foundry facings of all kinds, 25 per cent. ad valorem.

SUNDRIES.

Ships and other vessels, built in any foreign country, whether steam or sailing vessels, on application for Canadian register, on the fair market value of the hull, rigging, machinery and all appurtenances ; on the hull, rigging and all appurtenances, except the machinery, 10 per cent. ad valorem ; on the boilers, steam engines and other machinery 25 per cent. ad valorem.

Canoes, skiffs, or open pleasure sail-boats, of any material, 25 per cent. ad valorem.

Canvas, and sail twine of hemp and flax, when to be used for boats' and ships' sails, 5 per cent. ad valorem.

Blasting and mining powder, two cents per pound.

Cannon, musket, rifle, gun and sporting powder and canister powder, three cents per pound.

Nitro-glycerine, giant powder, nitro and other explosives, three cents per pound.

Glycerine, when imported by manufacturers of explosives, for use in the manufacture thereof in their own factories, 10 per cent. ad valorem.

Torpedoes, firecrackers, and fireworks of all kinds, 25 per cent. ad valorem.

Fertilizers, compounded or manufactured, 10 per cent. ad valorem.

Photographic dry plates, 30 per cent. ad valorem.

Emery wheels, and manufactures of emery, 25 per cent. ad valorem.

Among the free goods are the following items :

Anchors for vessels.

Blast furnace slag.

Brass and copper, old and scrap, or in blocks ; and brass or copper in bolts, bars and rods in coil or otherwise, not less than six feet in length, manufactured, and brass or copper in strips, sheets or plates, not polished, plainshed or coated, and brass or copper tubing, in lengths of not less than six feet, and not polished, bent or otherwise manufactured, and copper in ingots or pigs.

Britannia metal in pigs, blocks or bars.

Burr-stones, in blocks, rough or unmanufactured, not bound up or prepared for binding into mill-stones.

Emery in bulk, crushed or ground.

Felt, adhesive, for sheathing vessels.

Fire bricks, for use in processes of manufacture, or for manufacturing purposes.

Hoop iron not exceeding 3-8 inch in width and being 25 gauge and thinner, used for the manufacture of tubular nuts.

Ingot moulds; iron, sand or globules, or iron shot and dry putty for polishing glass or granite.

Iron or steel masts, or parts thereof, and iron or steel beams, angles, sheets, plates, knees, and cable chain for wooden, iron, steel or composite ships and vessels ; and iron, steel or brass manufactures which at the time of their importation are of a class or kind not manufactured in Canada, when imported for use in the construction or equipment of ships or vessels.

Locomotive and car wheel tires of steel in the rough.

Machinery imported exclusively for mining, smelting and reducing, viz.:—Coal cutting machines, except percussion coal cutters, coal heading machines, coal augers and rotary coal drills, core drills, miners' safety lamps, coal washing machinery, coke-making machinery, ore-drying machinery, ore-roasting machinery, electric or magnetic machines for separating or concentrating iron ores, blast furnace water jackets, converters for metallurgical processes in iron or copper, briquette making machines, ball and rock emery grinding machines, copper plates, plated or not, machinery for extraction of precious metals by the chlorination or cyanide processes, monitors, giant and elevators for hydraulic mining, amalgam safes, automatic ore samplers, automatic feeders, jigs, classifiers, separators, retorts, buddles, vanners, mercury pumps, pyrometers, bullion furnaces, amalgam cleaners, gold mining slime tables, blast furnace blowing engines, wrought iron tubing, butt or lap welded, threaded or coupled or not, not less than 2½ inches diameter, when imported for use exclusively in mining, smelting, reducing or refining.

Nickel ; and ores of metal of all kinds ; and silex or crystallized quartz.

Rolled round wire rods in the coil, of iron or steel, not over three-eighths of an inch in diameter, when imported by wire manufacturers for use in making wire in the coil, in their own factories.

Scrap iron and scrap steel, old and fit only to be re-manufactured, being part of or recovered from any vessel wrecked in waters subject to the jurisdiction of Canada.

Silver, nickel and German, in ingots, blocks, bars, strips, sheets, or plates, unmanufactured.

Steel rails, weighing not less than 45 pounds per lineal yard, for use only in the tracks of a railway which is employed in the common carrying of goods and passengers, and is operated by steam motive power only : provided that this item shall not extend to rails for tracks of a railway which is used for private purposes only, nor shall this item extend to rails for use in the tracks of any electric railway, street railway, or tramway.

Steel bowls for cream separators, and cream separators.

Steel saws and straw cutters cut to shape, but not further manufactured.

Crucible sheet steel, eleven to sixteen gauge, two and one-half to eighteen inches wide, for the manufacture of mower and reaper knives, when imported by the manufacturers thereof for use for such purpose in their own factories.

Steel of number twenty gauge and thinner, but not thinner than number thirty gauge, for the manufacture of corset steels, clock springs and shoe shanks, when imported by the manufacturers of such articles for exclusive use in the manufacture thereof in their own factories.

Flat steel wire, of number sixteen gauge or thinner, when imported by the manufacturers of crinoline or corset wire and dress stays, for use in the manufacture of such articles in their own factories.

Steel valued at two and one-half cents per pound and up-

wards, when imported by the manufacturers of skates, for use exclusively in the manufacture thereof in their own factories.

Steel, under one-half inch in diameter, or under one-half inch square, when imported by the manufacturers of cutlery, or of knobs, or of locks, for use exclusively in the manufacture of such articles in their own factories.

Steel of number twelve gauge and thinner, but not thinner than number thirty gauge, for the manufacture of buckle clasps, bed fasts, furniture casters, and ice creepers, when imported by the manufacturers of such articles, for use exclusively in the manufacture thereof in their own factories.

Steel of number twenty-four and seventeen gauge, in sheets sixty-three inches long, and from eighteen inches to thirty-two inches wide, when imported by the manufacturers of tubular bow sockets for use in the manufacture of such articles in their own factories.

Steel for the manufacture of bicycle chain, when imported by the manufacturers of bicycle chain for use in the manufacture thereof in their own factories.

Steel for the manufacture of files, augers, auger bits, hammers, axes, hatchets, scythes, reaping hooks, hoes, hand-rakes, hay-rakes, hay or straw knives, windmills and agricultural or harvesting forks when imported by the manufacturers of such or any of such articles for use exclusively in the manufacture thereof in their own factories.

Steel springs for the manufacture of surgical trusses, when imported by the manufacturers for use exclusively in the manufacture thereof in their own factories.

Flat spring steel, steel billets and steel axle bars, when imported by manufacturers of carriage springs and carriage axles for use exclusively in the manufacture of springs and axles for carriages or vehicles other than railway or tramway, in their own factories.

Spiral spring steel for spiral springs for railways, when imported by the manufacturers of railway springs for use exclusively in the manufacture of railway spiral springs in their own factories.

Steel strip and flat steel wire when imported into Canada by manufacturers of buckthorn and plain strip fencing, for use in the manufacture of such articles in their own factories; and barbed fencing wire of iron or steel after January 1st, 1898.

Galvanized iron or steel wire number nine, twelve, and thirteen gauge, after January 1st, 1898.

Stereotypes, electrotypes and celluloids of newspaper columns in any language other than French and English, and of books, and bases and matrices and copper shells for the same, whether composed wholly or in part of metal or celluloid.

Surgical and dental instruments (not being furniture) and surgical needles, after January 1st, 1898.

Tagging metal, plain, japanned, or coated, in coils, not over one and a half inch in width, when imported by manufacturers of shoe and corset laces for use in their factories.

Tin, in blocks, pigs, bars and sheets, tin plates, tin crystals, tin strip waste, and tin foil, tea lead.

Tubes, rolled iron not welded or joined, under one and one-half inch in diameter, angle iron, nine and ten gauge, not over one and one-half inch wide, iron tubing lacquered or brass covered, not over one and one-half inch in diameter, all of which are to be cut to lengths for the manufacture of bedsteads, and to be used for no other purpose, and brass trimmings for bedsteads, when imported by or for manufacturers of iron or brass bedsteads to be used for such purposes only in their own factories, until such time as any of the said articles are manufactured in Canada.

Wire, crucible cast steel.

Wire, rigging for ship and vessels.

Wire, of brass, zinc, iron or steel, screwed or twisted, or flattened or corrugated, for use in connection with nailing machines for the manufacture of boots and shoes, when imported by manufacturers of boots and shoes, to be used for such purposes only in their own factories.

Steel wire, Bessemer soft drawn spring, of numbers ten, twelve and thirteen gauge, respectively, and homo steel spring wire of numbers eleven and twelve gauge, respectively, when imported by manufacturers of wire matresses, to be used in their own factories in the manufacture of such articles.

Yellow metal, in bolts, bars and for sheathing.

Zinc spelter and zinc in blocks, pigs, sheets and plates; seamless drawn tubing.

THE NIAGARA ARCH BRIDGE.

The Niagara River is now spanned by three bridges, each of which was at the time of its erection a landmark in the engineering world, not only by reason of its vast proportions, but on account of those natural features which make the Niagara Gorge one of the world's wonders. These bridges represent distinct types of structure, the suspension, the cantilever, and the arch. The construction of an arch of such proportions never was attempted before.

The bridge which the arch has replaced was completed in 1855, the first train passing over it on March 8th of that year. Seven years were consumed in its construction. The original bridge had wooden trusses suspended on stone towers. In 1880 the suspended structure was changed to steel, and in 1886 the stone towers were replaced by towers of steel, both changes being made without any cessation of train

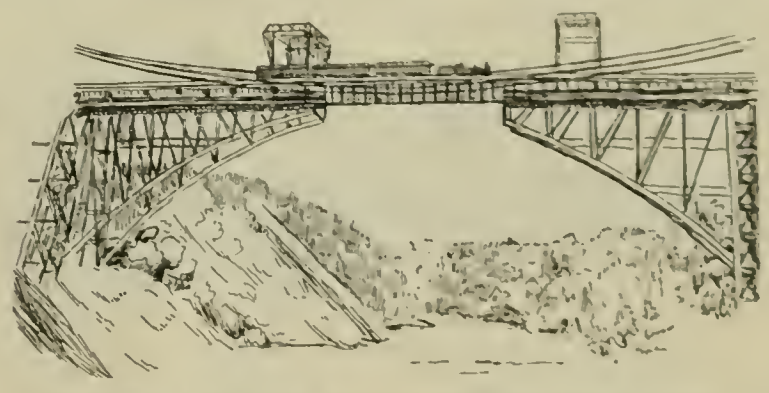
NEW NIAGARA ARCH BRIDGE

traffic. The bridge had a span of 821 feet from centre to centre of the towers, and was suspended on four wire cables 10¼ inches in diameter, which carried a single track railway above and a carriage way on the lower deck. The engineer who designed and superintended the changes in the bridge was L. L. Buck, of New York, who also prepared the plans for the new structure.

The new arch has a span of 550 feet between the end piers, and a trussed span at each end 115 feet long connects the arch with the bluff. The total length of the bridge with its approaches is 1,100 feet, and the centre of the arch 226 feet above the water. The steel ribs or main arches are four feet deep and three feet wide.

The bridge has two floors. On the upper floor there are two railway tracks, and on the lower floor a central carriageway, a double trolley track and sidewalks on each side. The width on top is 30 feet. The lower floor is 57 feet wide. The arch will support on each upper track at the same time two locomotives of the heaviest kind, followed by trains weighing 3,500 pounds to the square foot of bridge, and in addition a load of 3,000 per square foot on the lower floor. Seven million pounds of steel have been used in the building of this wonderful arch.

On the United States side of the river the bed plates of the arch rest on masonry built on the limestone rock, but on the Canadian side it was found necessary to build a foundation of concrete on which the masonry rests. The abutments are built about half way up the slope on each side. The stone for the abutment on the Canadian side was



NEW NIAGARA ARCH BRIDGE - UNDER CONSTRUCTION.

brought from the Queenston quarries. The bridge end of the shore span is hinged to the arch, and the shore end rests on expansion rollers on heavy masonry abutments. During construction the arch was supported as it was built out by a chain of vast strength made fast to a huge anchor sunk in solid masonry.

The test of the bridge was made July 29th, and R. S. Buck, the engineer in charge, said that "the test was very satisfactory in every respect. The weight which was placed on the bridge was about 2,600 tons, and is in excess of any that the bridge will be required to stand. The deflection was about an inch, which shows that the bridge is one of the strongest of its kind ever constructed. The test was in every way satisfactory to the bridge companies, the engineers, the Grand Trunk Railway, and the Pennsylvania Steel Company." This was endorsed by L. L. Buck, the designing and chief engineer. Among the officials present at the test were: Joseph Hobson, Montreal, chief

engineer of the Grand Trunk Railway; George L. Burrows, Saginaw, Mich., president of the Niagara Falls International Bridge Company; T. R. Merritt, St. Catharines, president, secretary and treasurer of the Niagara Falls Suspension Bridge Company, of Canada, these two companies being owners of the new bridge; L. L. Buck, of New York, the designing engineer, who had charge of the test; R. S. Buck, resident engineer, who supervised the construction of the bridge; J. B. Frame, Harrisburg, Pa., superintendent of the Pennsylvania Steel Company; Thomas R. Reynolds, the superintendent of the bridge companies; and Ross Mackenzie, Toronto.

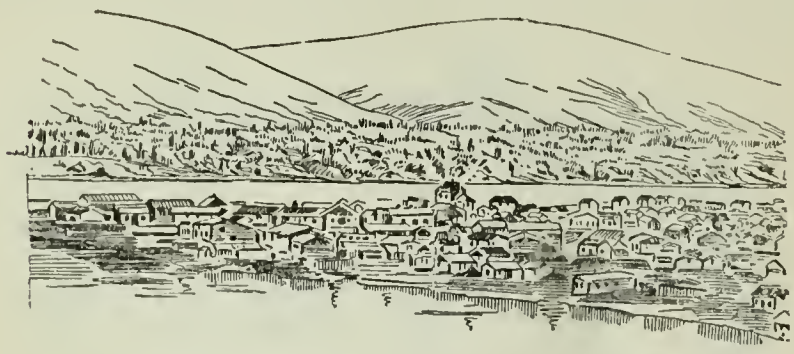
The formal opening of the bridge will not take place for a month or so, when it is hoped that Sir Charles Rivers Wilson, president of the G.T.R., will be able to be present.

BRITISH YUKON MINING REGIONS.

A SKETCH OF THE GREAT CANADIAN ELDORADO OF THE NORTH.

Although the fabulous finds of gold in the placer diggings of the streams and rivers tributary to the Canadian Yukon have only now begun to send a wave of excitement over the civilized world, the existence of rich gold finds there is not a discovery of to-day. For sixteen years or more gold has been mined along the Yukon and its tributaries, and, while the principal mining camps in the early days were in the American territory of Alaska, as long ago as 1887 we have official reports of extensive placer mines on the Canadian side, in which even then 300 miners were at work. The first official investigation of that region was undertaken by direction of the late Hon. Thos. White, then Minister of the Interior, who sent an exploring expedition, under Dr. G. M. Dawson and Wm. Ogilvie, the former one of the ablest geologists, and the latter one of the most skilful and courageous surveyors ever employed by the Dominion Government, and the value of whose technical skill is heightened so much by modesty and integrity.

Their explorations laid a healthy foundation for the developments which have since taken place in the Canadian Yukon region. As long ago as 1840 Campbell was commissioned by Sir George Simpson, of the Hudson Bay Co., to explore the Upper Liard. He traversed a part of the Pelly River Valley, and seven years later Fort Yukon, at the mouth of the Porcupine River, was established by the Hudson Bay Co., under A. H. Murray. In 1848 Campbell erected Fort Selkirk, which, however, was plundered by the Indians in 1852, and is now in ruins. In 1869 the Hudson Bay officers were expelled from Fort Yukon, which was found to be in American territory, and moved their trading post to Kampart House, but in 1890 it was found that this also was a few miles within the United States territory, and they were compelled to shift twenty miles up the Porcupine River. For many years, dating from 1873, private trading was carried on, chiefly by two traders named Harper and McQuestion, who had a partnership for some years. Harper is now at Fort Selkirk, and McQuestion is employed by the Alaska Commercial Co., at Circle City. For some years the trading by corporations in Alaskan territory has been largely a monopoly possessed by the Alaska Commercial Co., who may be called the Hudson Bay Company of the U.S. But in 1892 a Chicago corporation, known as the North American Transportation and Trading Company, started a line of steamers trading to Alaska. From dealing in furs and other northern produce, these and private corporations have become large carriers of passengers and freight for the mining regions. And so rapidly have developments taken place that transportation by rail from British Columbia and the North-West Territories, and even from Ontario via Hudson Bay, west across the McKenzie basin to Yukon, are now problems that require early solution in the handling of traffic.



FORTY MILE CAMP.—FROM A PHOTOGRAPH.

In 1894 the Canadian Mounted Police appeared on the scene of the placer diggings of the Upper Yukon, and established a post at Fort Cudahy, at the confluence of the Forty Mile Creek and Yukon River, under Inspectors Constantine and Strickland. By this date it was estimated that one thousand men were employed in mining there, and that the miners had taken out $300,000 from the Forty Mile Creek. At that time it appeared that the finds were chiefly in streams having their sources in United States territory, but as prospecting proceeded farther up the Yukon and tributary streams it was found that still richer diggings were found in the beds of rivers and streams wholly within Canadian territory. The inspectors estimated that there were 1,400 miles of streams in this district, in all of which gold could be found in paying quantities, and an old Swedish miner, who had been in California and British Columbia in the days of placer digging, said to one of the Government officials: "I never saw a country where there was so much gold, and so evenly distributed." This remark was made in 1887. One stream after another was prospected, and

FRONT OF NORTH-WEST MOUNTED POLICE POST—"WOOD-FATIGUE" DAY—WINTER SCENE—YUKON.

as fresh miners came in the area of discovery widened till creeks and streams almost by the score could be mapped out. When the enormous finds on the Klondike and Eldorado Creek became noised abroad these streams, nearly all of which would yield a good return for the miners' labor, were deserted until Dawson City, the centre of distribution of supplies for the Klondike, was estimated to have a population of from three to four thousand miners at the beginning of this year.

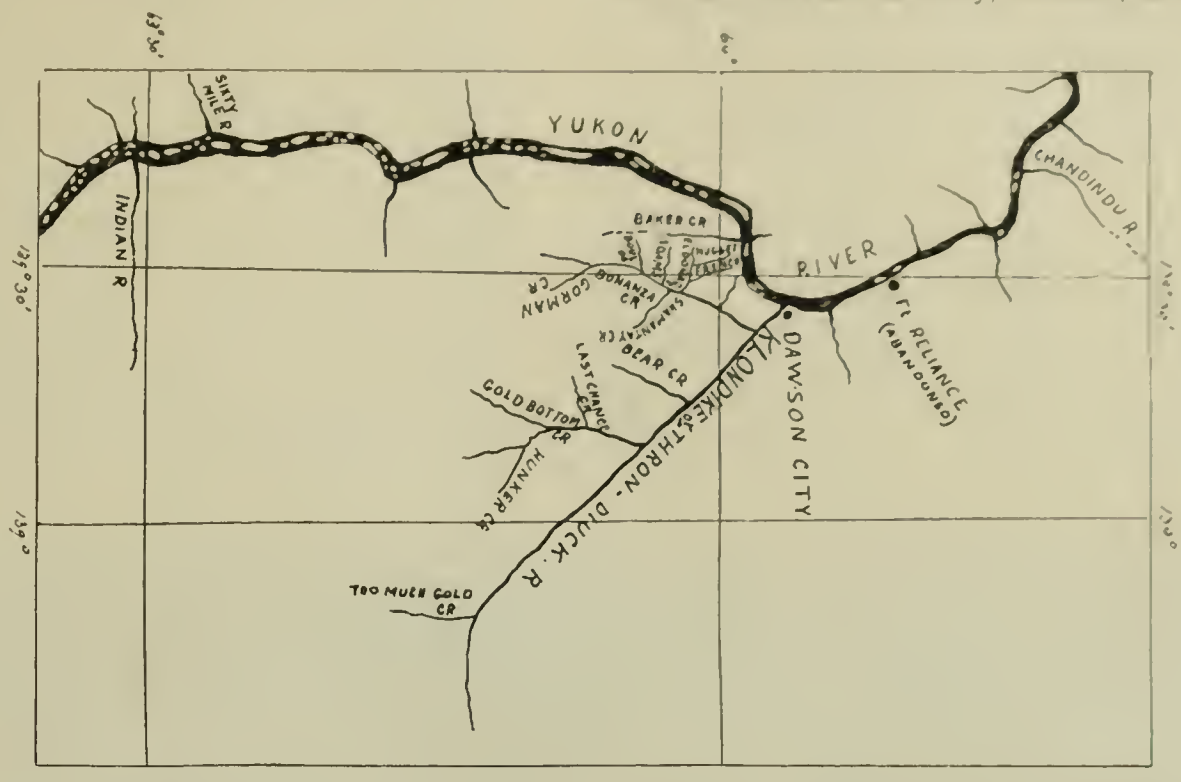
No doubt many of the stories of big finds are exaggerated, but we have before us a variety of evidence sufficient to show that, making due allowance for these exaggerations, the placer gold mines of the Klondike and other streams of the Canadian Yukon are the richest ever discovered in the world, and if this unprecedented richness exists in these alluvial deposits the quartz rock from which these golden grains have been washed must be equally unprecedented. The sources from which these river washings have come have naturally not yet attracted the miners in this inhospitable clime. For while such astonishing results can be obtained by simply washing the river sand with primitive appliances, they have not seen the necessity of attempting to bring up machinery for quartz mining, where transportation and living are so enormously high.

It should be mentioned, however, that the official reports of Dr. Dawson and Mr. Ogilvie show the existence of at least the beginnings of these gold-bearing quartz beds. In June, 1896, they found samples of quartz in a hill called Cone Hill, in the valley of the Forty Mile River, which assayed better than the celebrated Treadwell mine on the coast of Alaska, and the whole hill appeared to contain gold. A ledge of quartz was afterwards discovered on Twelve Mile Creek (the Chandindu), which appeared to be richer even than that of Cone Hill.

The question next in importance to that of the gold itself is the amount and convenience of fuel supply, and it seems a providential combination of the bounties of nature that the coal seams have been discovered which show beyond question that extensive mines of coal exist in the very midst of this wonderful gold mining tract. In fact the Canadian Yukon is another Transvaal, only on a still vaster scale. In the Transvaal the large deposits of coal that were found within convenient distance by rail of the Witwaters Rand field made that country what it is to-day. In 1887 Johannesburg was a Boer farm. Now it is a city of over 70,000 inhabitants, and the mines are equipped with the most scientific machinery known in the history of mining. The climate of the Yukon district may prevent its development from running on parallel lines with the

Transvaal, but there seems to be but little doubt that it will be the source of even greater wealth. Coal has been found on the Lewes River, above Five Finger Rapids. On Coal Creek, five miles below Forty Mile Creek, it has been discovered in ledges five to seven feet thick, and on Twelve Mile Creek there are also extensive deposits, as well as on the Chandindu River.

The Klondike is variously recorded on maps and charts as Thron-diuck, Throndik, Chandik, Tondak, Klondik, and Klondike. The first spelling is considered by Mr. Ogilvie to be the correct one. One authority gives "plenty of fish" as the meaning of the word, and another gives "reindeer," and it is put on some charts as the Deer or Reindeer River. The word Klondike seems likely, however, to come into general use.



In January, this year, still further deposits of coal were found in the upper reaches of the Klondike. It appears to be nearly all lignite coal of a good quality, and at the present date there appears to be little doubt that the quantity is sufficient to supply cheap fuel for a large population, not only for manufacturing and mining, but for domestic use.

The other minerals discovered and reported on officially are galena, in combination with gold, asbestos and copper, specimens of native copper having been brought in by Indians during the past year. What other minerals may be found only time and the perseverance of the prospectors in those regions can determine.

It would be impossible to give a correct estimate of the amount of gold already taken out of the Klondike. The table made of the finds made by miners returning on a single small steamer, the "P. W. Weare," showed that eight of these passengers brought down a total of $460,000, and other passengers had amounts varying from $10,000 to $30,000. Some of these passengers, however, refused to disclose the amount of their finds. The captain of another steamer, the "Portland," estimated the amount of gold brought down on his ship at $1,000,000. These and other boats returned from Alaska all within the month of July, and the total amount brought down this season has been calculated at from $2,000,000 to $5,000,000. It is on record that

one man obtained from one pan of dirt $204, from another $212, and from a third $216, these being the three biggest pans authentically reported. Two miners working on claims of their own cleaned up $6,000 from a single day's washing. In Bonanza Creek pans have varied from $1 to $12 per pan, but this means from $1,000 to $12,000 per day by sluicing. Mr. Ogilvie estimates the average in that creek at $5 to $7 per pan, and as this bed is 30 feet deep and 500 feet long, this means at the lower calculation, $4,000,000 in one creek. Mr. Ogilvie says there are here at least 15 miles of rich dirt.

Assuming corresponding riches in the other streams, a faint idea may be gathered of the value of gold stored in this part of Canada.

This wealth, almost surpassing any story in the world's library of fiction, is not to be got without effort, and it would be unwise to conceal the difficulties or to underestimate the self-sacrifice required of adventurers in these parts. The winter lasts nearly nine months of the year, and in midwinter during the last two years Mr. Ogilvie has recorded temperatures as low as 68 deg. below zero. In the Canadian territory, however, the atmosphere is dry by reason of its inland situation, and the winters are more tolerable here than along the American coast in the same latitudes. By dressing warmly in closely-woven woolen garments (but preferably in fur garments, after the Laplander style), many miners pass the winter in tolerable comfort, if not in positive enjoyment. While in the short summer the thermometer sometimes dips to the freezing point, or even below, the temperature frequently runs up to 100 deg. in the shade. This may seem surprising to inhabitants of lower province latitudes, but it must be remembered that in the latitude of between 60 and 65 (in which is enclosed the rivers and streams under present consideration), there is continuous daylight from the middle of June to the middle of August, and even longer as you approach the Arctic circle. The illustrations shown in connection with this sketch, taken as they are from photographs, show a greater profusion of vegetation than one would expect, and it is a fact that vegetables such as onions and turnips have been grown within the last two or three years, and no doubt other vegetables and plants can be grown when the peculiarities of the climate are better understood. Two or three kinds of native grasses, which afford food for cattle, are to be found in some of the numerous valleys extending along these rivers; and doubtless other grasses can be introduced and acclimatized. Mr. Ogilvie estimates that there are about 360 square miles of arable land in the region he explored, but a good deal of this is not rich. It is therefore hardly likely that the farm lands of this region can do more than supplement the importations of food stuffs that would have to be brought from Eastern Canada. But given plenty of gold, railway transportation will in the future carry comfort to the inhabitants of the Yukon to the great advantage of every other part of Canada. While the products of the soil are a question of the future, miners can count on a considerable amount of fish and wild game. Cariboo are to be found on the uplands, and though moose have been killed off from the immediate vicinity of the miners, they are more plentiful in the inland districts. The grizzly, brown, black and silver-tipped bears are more or less plentiful, though not to be had without a spice of danger. The Arctic bear, which mysteriously swarms in countless numbers every seven years, and then, after two or three years, as mysteriously disappears, is a welcome source of food in its plentiful years. The mountain sheep and mountain goat, similar to those in British Columbia, are plentiful in the mountains. Of fur-bearing game there is the grey, black, and red foxes, the marten, the lynx and a few otter. Bird life is not so plentiful. The white-headed eagle, the raven, the magpie, the ptarmigan, wild geese and ducks, loons, and a bird like our Eastern chicadee, but larger, are the principal wild birds. Of these the ptarmigan, geese and ducks are the most plentiful. The fish of the rivers and small lakes are the salmon and lake trout, and a species of Arctic trout.

FORTY MILE TOWN.

The timber of this district is chiefly poplar, spruce and pine. It is of a stunted growth in the neighborhood of the present mining camp, but in other parts grows very well. Even along some of the mining streams poplar is found eight or ten inches in diameter, especially round Lake Labarge.

There are two main routes at present to the Yukon. One is from the mouth of the Yukon, in American territory, up the Yukon to its tributaries. Another is by the Lynn channel, from which three different passages lead to the mines—the Chilcoot and the Taiya mountain passes, and another is by the same channel, through an easier pass, called the White Pass, and named after the late Hon. Thomas White. The old Yukon route is the longest, and, as the river is swift and has many windings and is open for navigation only about three months in the year, it is manifest that a railway from British Columbia

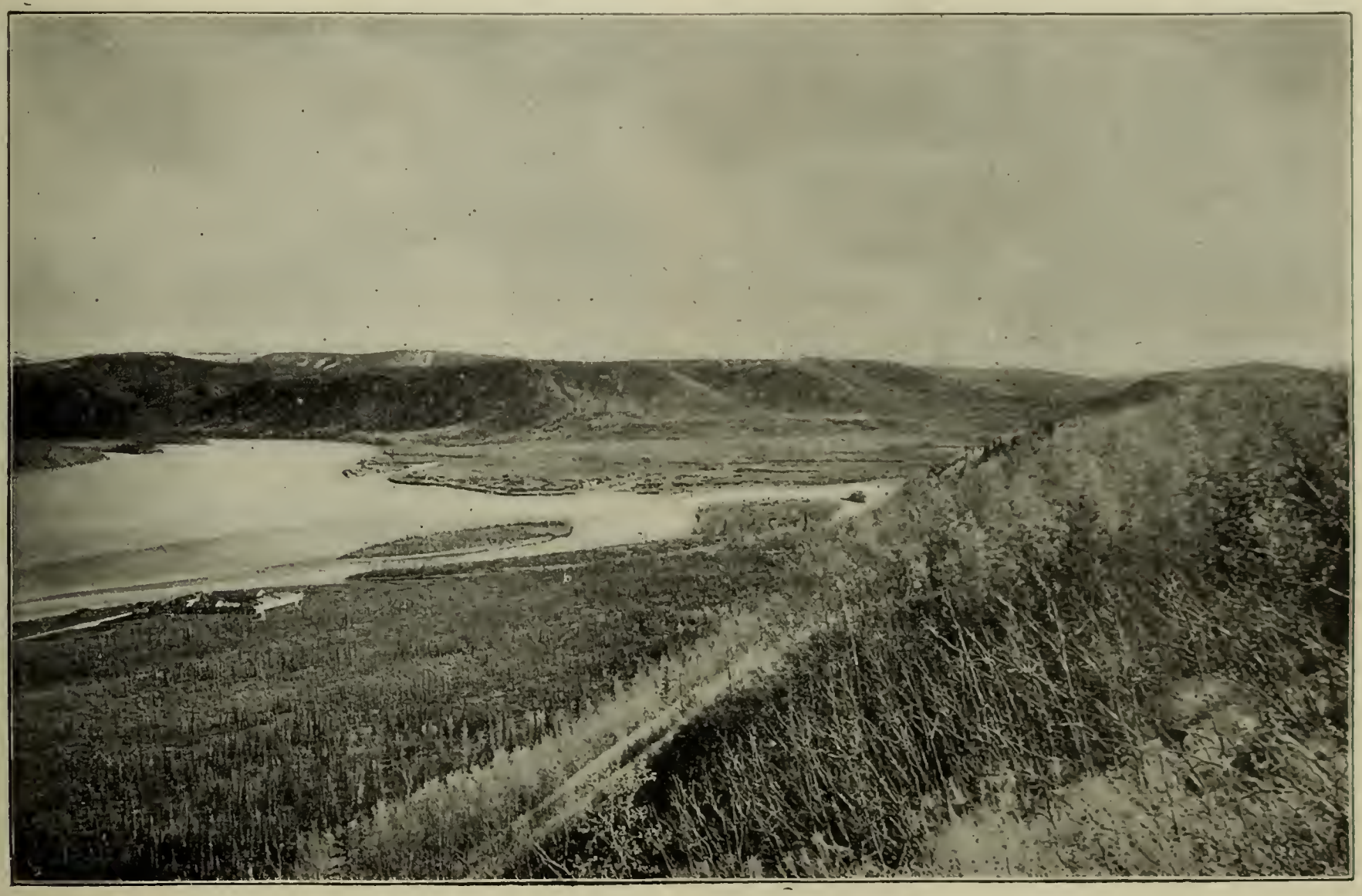
or by Hudson Bay, across the continent, must be the route of the near future. Mr. Ogilvie estimates the rate of discharge of the Yukon River at about 300,000 cubic feet of water per second. This is about one-third of the discharge of the St. Lawrence, but greater than the discharge of the Mississippi, and four times that of the Ottawa. The Yukon is navigable for about 2,300 miles, but in many places is shallow, and has to be navigated by flat-bottomed boats, especially built for this work. A new fleet of 10 or 15 of these boats is now being built by the British Yukon Company for service on the Canadian Yukon, connecting the mining camps with the different mountain passes over British Columbia, a distance of 620 miles. Some will also ply on the lower Yukon. The miner is aided over these passes by dog-sleds and the uncertain help of Indians. But appliances are now being brought in to surmount the most difficult parts, and the next improvement will be the railway. Already the British Yukon Company contemplate a narrow-gauge railway over the White Pass, during the coming spring, and the C.P.R. contemplates making a connection with the Yukon from Edmonton. A line of about 50 miles from Edmonton would reach Athabasca Landing, from which a water route would be open via Athabasca River and Lake, Great Slave Lake and River, and the McKenzie River, to Port McPherson. This would make the distance from Edmonton to Port McPherson (which is quite near to the Klondike divide) 1,800 miles, as against a total of 4,300 miles from Seattle to the mouth of the Yukon, and up that river through American territory. A rail route by the White Pass presents fewer engineering difficulties than was at first imagined, and it would be available all the year round, as against three months by the Yukon route. An American and Canadian Customs port of entry has been established at Dyea, within Canadian territory, and this step may be accepted as an admission of the independence of the Lynn Channel route. The question of the main boundary along the British Columbia coast being yet undefined, the Dominion Government is taking steps to conserve the public interests by regulations providing for the reservation of alternate claims, and for the payment of royalties on the claims already allotted. But judging by the reports of the influx of miners from all quarters, it would be well for the Government to increase the detachment of the Mounted Police sent up to maintain order, this detachment at present numbering 80.

Meantime only active, healthy men should undertake this journey, and ample provision should be made in the way of supplies and food.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain for June, 1896 and 1897, and the six months ending June, 1896 and 1897

	Month of June.		Six months ending June.	
	1896	1897.	1896	1897.
Hardware and cutlery	£4,618	£6,283	£32 111	£31,939
Pig iron	2 086	1 847	9,966	2,[illegible]5
Bar, etc.	2,202	805	8,501	5,013
Railroad	25 437	——	47,475	20,[illegible]6
Hoops, sheets, etc	4,446	6,245	16,142	22,690
Galvanized sheets	7,652	3,377	23,854	19,375
Tin plates	11 435	7,981	67,554	8[illegible],953
Cast, wrought, etc., iron	4,535	2,369	26 103	17,334
Old (for re-manufacture)	5,865	925	8 926	1,497
Steel	7,680	4,953	44 407	23 435
Lead	2,113	2,806	7,556	7,26[illegible]
Tin, unwrought	640	909	7 714	9 83[illegible]



JUNCTION OF FORTY MILE CREEK AND YUKON RIVER. (RIGHT HAND VIEW.)

—Commenting on the treatment which the city engineer of Toronto, E. H. Keating, receives at the hands of the city council, the Toronto *Evening News* says in a recent editorial: "The attack upon the Engineer's department, by the aldermen, is not a new thing in the City of Toronto. As far back as the memory of the oldest inhabitant can go, the Engineer has been treated as good game for designing members of the council to go after when they think their interests demand an exhibition of economy. It is so easy for a contractor like Ald. Gowanlock to criticise an official, and it is such a popular proceeding with a certain section of the electorate, that there need be little wonder at the frequency of the attacks. The same applies to other aldermen. It was not otherwise twenty-five years ago, when Walter Shanly was city engineer. The interference and senseless criticism of the aldermen drove him out of the city's employ. He told his committee candidly that he would not be directed by a parcel of ignorant men as to how he should carry out his work, and sent in his resignation. Mr. Jennings' experience was almost identical with that of Mr. Shanly. He refused to accept the dictation of men who knew no more about engineering than a monkey does about algebra, and the consequence was he had to resign. The aldermen of the City of Toronto worried Charles Sproatt into his grave. They loaded him with work that would have kept four men busy, and when anything went wrong he was made the scapegoat for the meddling members who were to blame."

CORRECTIONS.

In the account of the manufacture of carborundum which appeared in last issue, "sugar" was given as one of the ingredients. It should have been "coke." A slight error also appeared in the description of the London and North-Western Railway, in which the distance between London and Liverpool was given as 100¾ miles. It should have been 200¾ miles.

FIRES OF THE MONTH.

July 16th.—Royal Pulp and Paper Company's new mill, pulp mill and blacksmith's shop, East Angus, Que. Loss, $150,000.—July 13th—Anderson's planing mill, Sudbury, Ont. Loss, $7,500.—July 19th—The McKay Milling Company's flour mill, Ottawa, Ont., damaged to the amount of $17,000.—July 22—C. F. Langevin & Co.'s saw mill, grist mill and woolen mill, Acton Vale, Que. Total loss.—July 25—T. Bunn's foundry machine shop, Cayuga, Ont. Loss, $2,000.—July 25th—J. Henley's saw mill, St. Gabriel, Que. Totol loss.—July 25th—Toronto Brass Co., Toronto; damage amounting to $2.500.—July 25th—Eastern Abattoir, Montreal. Loss, $100,000.—July 27th—C.P.R. car shops at Carleton Place, Ont.; damages amounted to $2,000.—July 28th—Standard Oil Co.'s warehouse, Winnipeg. Loss, $25,000.

Mining Matters.

The Echo Mining Company, in Slocan, will build a tramway to Sandon, and erect concentrators.

An inventor has recently communicated to the Ontario Bureau of Mines a new method of reducing nickel ores without roasting them. The department will investigate this process.

The Lucky Jim Gold Mining Co., Sandon, B.C., has ordered from the Jenckes Machine Co., Sherbrooke, Que., through its Rossland branch, the iron work for one three-wheel tramway.

The Citizens' Coal Co., Sudbury, Ont., has decided to get machinery to sink a shaft. At 80 feet they struck four feet of mineral. Furnace tests are said to show good burning qualities.

Prof. Goodwin, of the Kingston School of Mines, has recently set up an exhibit of minerals, at Rat Portage, Ont., which will be of much interest and value to everyone there interested in mineral development.

The Colonna Gold Mining Co., Rossland, B.C., is putting in an air pipe line to connect its two properties. This has been bought through the Rossland branch of the Jenckes Machine Company, Sherbrooke, Que.

The Dardanelles Mining Co, at Kalso, B.C., has placed an order with the Rossland, B C., branch of the Jenckes Machine Co., of Sherbrooke, Que., for a complete mining plant for operating its properties in that district.

Alexander McCoy, Sault Ste. Marie, Ont., has discovered gold in the vicinity of Michipicotten river, north of the famous island of Michipicotten, where considerable mining for copper was done by H R. Fletcher fifty-two years ago.

A charter has been granted to Hon. Geo. Cox, Wm. Mackenzie, G. H. Bertram, J. S. Playfair, A. Horton, A. Cox, A. Angstrom, M.E.; S. C. Smoke and J. H. Bertram, Toronto, as the Mines Investment Association of Ontario, Ltd., to do a general mining business.

The erection of the Fraser & Chalmers' mill at the Saw Bill mine was done under the direction of S. B. Schrontz, one of Fraser & Chalmers' men, who has, it is said, superintended the construction of some of the biggest plants on the continent.

The gold excitement on the Saskatchewan river, N.W.T., still continues. This spring a large number of new dredges were constructed, and several work at night by electric light. Claims are staked out along both sides of the river for a distance of a hundred miles.

The Elgin Field Oil and Gas Company, who have been boring for oil and gas in Dunwich township, near Tyrconnell, Ont., have struck an immense flow of gas at a depth of 130 feet. The gas was found in a twenty-foot bed of gravel just above the rock, and there was no water with the gas.

The Philadelphia capitalists, Stevenson & Son, who own the Highlander mine at Ainsworth, B.C., have arrived with the machinery for putting in the tramway and concentrator. The tram will run from the Highlander to the lake, and it is expected that the concentrator will be running by the end of August.

The Jenckes Machine Co., Sherbrooke, Que., shipped to the American Asbestic Co., Danville, Que., recently, one of their 20-drill air compressors, together with three high speed crushing rolls and two picking tables, being a plant required by the Asbestic Co. in connection with the extension of its operations.

The calcining and refining furnaces of the Hall Mines smelter at Nelson, B.C., not long ago turned out the first copper produced in British Columbia. It carries 97 per cent. of copper, silver and gold, which is as fine as it can be made in furnaces of this nature. The value carried to the ton is $530, including about $50 in gold.

The Jenckes Machine Co., Sherbrooke, Que., has just completed for the Sultana mine at Rat Portage, Ont., one 30-stamp mill, with six vanners, one 150 h.p. Corliss engine, with complete equipment of boilers, compressor and hoisting plant. This is said to be the largest and most complete plant of this kind in the Lake of the Woods district.

The Ibex mine has let a contract for packing 500 tons of ore. Foss & MacDonnell have a contract to build a tramway, which will be 6,000 feet long. Fifty men are now at work on it, and will have it completed by October. The Canadian Pacific Railway surveyors are locating a wagon road from Three Forks to McGuigan and Bear Lake, a distance of five to six miles.

The Hiawatha mine is on Clear Water Lake in the Saw Bill country, and it has four veins from 2 to 8 feet wide, and assaying from $7 to $17 to the ton in gold. Vein No. 1 has been uncovered for 116 feet, No. 2 for 400, No. 3 for 630 and No. 4 for 250 feet. Seven test pits from 6 to 15 feet in depth have been sunk with, it is said, encouraging results, and a shaft is being put down on vein No. 2.

The directors of the Calumet and Hecla Mining Company paid an "extra" dividend of $5 per share, July 7th, to stockholders of record June 11th. The last previous dividend was $5, and was paid April 23rd. The total payments thus far this calendar year have been $30 per share, as against $25 for the corresponding period last year. The two declarations call for $1,000,000, and bring the company's aggregate dividend disbursements up to $49,850,000.

The Commander Mining and Smelting Co. wrote to the Canadian Rand Drill Co., Sherbrooke, Que., a short time ago as follows: "Gentlemen—We have run 570 feet, 5 x 7 foot tunnel, in the hard rock of this camp in the past 7 months, with one of your 2⅛ Seuggar drills and compressors, at an expense for duplicate parts and repairs on the above drill of only $4.65, which expense includes two throttle handles and rubber buffers. Yours truly, J. Houghton, Supt. Commander Mining and Smelting Co."

We are in receipt of the Directory of Mines for May, 1897, published by the *Mining Record*, Victoria, B.C. The book contains a complete synopsis of the mining laws of British Columbia, with amendments passed at the late session of the legislature, compiled by Archer Martin, barrister-at-law, Victoria, B.C. In addition to the above, much useful information relating to the mines and mining generally is included. Those wishing to know the state of the mining laws as they stand to-day should procure a copy of the work.

Petroleum has long been known to exist in the Gaspe peninsula of Quebec, and several years ago a company known as the Petroleum Oil Trust was formed to search. Oil of a light green shade, of fine quality, like that of Pennsylvania, was found in several places, but not in paying quantities. At last, after several years and much money spent in prospecting, oil has been struck in lot 40 in the township of Galt. The day after the strike was made (22nd of July) a ten barrel tank was made and filled in two and a half minutes, or at the rate of over 5,000 barrels a day. There is great excitement among the people in the parishes of Galt and Baillairge.

Nova Scotia gold mining shows much activity and bright prospects. About the middle of last month, Dr. John H. McKay and Geo. W. Stuart returned from Sherbrooke, Goldenville and Wine Harbor, and reported developments on the Napier property at Wine Harbor most encouraging. A trial lot of rock from one lead gave 17 dwt. per ton. Goldenville is now a busy mining camp, besides the Bluenose and New Glasgow Co.'s producing regularly their large bricks. Geo. Hirschfield has recently leased from Mr. Stuart a small area, from which he took, for the month of June, 228 ounces of gold, netting him a profit of $3,000.

W. G. Miller, professor of geology at the Kingston School of Mining, is now employed by the Government in making a geological exploration of the eastern counties of the province, doing for that section practically the same work that Dr. Coleman is doing in the west. The special service in which he is engaged is the examination of known deposits of corundum, with a view to studying the geological relations of this valuable mineral. He will also explore for gold and other ores, and will send in a report of his work to the Bureau of Mines. The

counties over which his investigations will range are Peterborough, Hastings, Addington, and Frontenac, particularly in the northern portions, which are mineral-bearing.

The Le Roi Company paid two dividends of $25,000 each, in July, making $475,000 paid in dividends by the company. To the disappointment of British Columbia people, the company has located its smelter at Northport, on the American side. A correspondent says the "purchase of the Pilot Bay smelter, by the Grant and Omaha Company, is confirmed, and is regarded as a proof that had the Le Roi people really desired to locate their reduction works in Canada, they could have done so with advantage in the end. The various statements made by the company, from time to time, are regarded as so many pretexts to avoid the export duty later on. The precedent is not likely to be followed."

An important syndicate in London, England, has acquired 108,000 acres of mining lands on the north shore of Lake Superior, including the Silver Islet mine, and has begun exploratory work, with a view to testing the value of the property. The Silver Islet Mining Company has for a number of years past owned some very extensive properties on the north shore of Lake Superior, comprising 108,000 acres, which extend from Pigeon River to the "Soo." These lands, amongst which was the celebrated Silver Islet mine, were obtained from the Montreal Mining Company, which latter had conducted exploratory work on them about the year 1885-6. When operations on Silver Islet mine suspended, silver to the value of over $3 000,000 had been taken out of the mine.

A discovery of fabulously rich milling ore has been reported on the northern shore of the Gulf of Georgia, B.C., 140 miles from Vancouver. Every piece of rock taken out of the vein, which is said to be ten feet wide, is ribbed around with coarse gold, which assays many thousands of dollars to the ton, and the specimens are far richer than any before seen in the province. Like all other rich strikes, this was found by accident. Hundreds of prospectors have scoured the country and the one who made the strike had given up the search. He was digging a trench around his tent when he struck the gold seamed rock. He was found a week later raving mad; the excitement caused by the rich find had turned his head, and the only words he could say were: "I have found it." Very rich free milling finds have also been made in Lillooet and Soquansht.

The report of the Dominion Coal Company, N.S., for the year ending February 28th, 1897, shows that the net proceeds from coal mined were $303,038 and transportation profits $286,263, a total of $589,301. The payments were:—General expenses, $80,548; interest and sinking funds, $267,937; dividends. $166,667; total, $515,152. This leaves a surplus of $74,149, which added to the balance of $18,-214 brought forward from the previous year, leaves a surplus of $92,-362 carried forward to the current year. President Whitney's report says: "The output for 1896 was 1,169,785 tons. This is larger by 284,881 tons than for the previous year. During the latter part of the year it was found desirable to erect a coal-washing plant. This was proceeded with, and is now in operation. It has proved economical and effective in increasing the market value of the smaller grades of coal. The satisfactory results of last year's work were due largely to our increased output and saving in cost of mining and transporting the coal."

B. E. Walker, general manager of the Bank of Commerce, said in a recent speech to the directors of the bank: "It is well to remember that if mining pays fair wages to those engaged in it, and a fair dividend on the capital employed, that is all we have the right to expect. The world is full of men looking for only fair wages and of capitalists seeking only a fair dividend. It is also well to remember that mining is a business requiring large capital, and apt to absorb the first earnings as a further investment of capital before settling down to the payment of steady dividends. It also requires, like any other manufacturing venture, absolute knowledge of the business in all its details, if success is to be confidently relied on. But like other manufacturing ventures, if skill and capital are properly applied, the result will, in the majority of cases, justify the venture. We hope, however, it will not be taken amiss if we compare this kind of mining with much that is going on in Canada at the present. Many of the ventures offered to the public do not seem to be backed up by skill in the particular business of mining and adequate capital, and in such ventures hundreds of people are risking sums, not large in themselves, perhaps, but of great consequence to the owners, who in the majority of cases we fear must lose. No one really interested in the great future which mining doubtless has in Canada, will, we think, dispute the wisdom of such a note of warning at the present time."

Wm. Buck, the well known stove manufacturer, of Brantford, Ont., died very suddenly from heart disease, while attending a performance of the Wild West Show recently.

Railway Matters.

Moncton's (N.B.) new railway station is to be buffed brick with stone trimmings.

Extensive changes are being made in the C. P. R. shops, Granby, Que., for the purpose of manufacturing cars

T. Pegnem, a sub-contractor for Foley Bros., on the Crow's Nest Pass Railway, took a number of laborers out from Montreal

Premier Greenway states that he expects to complete the contract for the construction of the Winnipeg-Duluth Air line before the end of August.

Foley Bros., of St. Cloud, Minn., formerly of Almonte, Ont., have the contract for constructing 34 miles of the Crow's Nest Pass Railway from Lethbridge.

The minister of railways has given notice to the C. P. R. that the arrangemeut by which it uses the Intercolonial from St John N.B., to Halifax, N.S., will terminate in a year

The South-Eastern Valley Railway Company having obtained leave from the Federal Government to cross the Vermont Central Railway line near Ibervillle, Que., will commence their work of construction.

The erection of the new east end (Dalhouise Square) station and hotel of the C.P.R. in Montreal is going on rapidly, and the contractors are ahead of their time. The station will have eight tracks for passenger trains and four for baggage and express work.

The steamer "Coban" is taking a load of material for the bridges on the Newfoundland Railway, which is now nearing completion. As soon as the road is finished the steamer "Jubilee" will make regular trips from the western terminus of the railway to Sydney, N.S. The "Jubilee" is soon expected out from Scotland.

The Grand Trunk Railway work shops in Toronto are being removed to London. In future the repairing of all heavy cars will be done in the Forest City. There have been 120 men employed at the shops in Toronto; 100 of these will be sent to London, while the others will remain in Toronto to do small repairs.

MacKenzie & Mann, contractors for the Lake Dauphin Railway, have been notified by Premier Greenway, of Manitoba, railway commissioner, to cease in their construction operations on the road, and the workmen have been recalled. The intention was to construct the additional 25 miles this summer, connecting the line with Lake Winnipegosis.

On the 1st June the Dominion Government ceased to operate the Baie de Chaleurs Railway, which has been handed over to the Atlantic and Lake Superior Railway Company. The rolling stock of the old road is mostly under seizure, and the A. and L. S. Co. have to supply rolling stock to keep it going The extension will be built when the company can finance its bonds under the arrangement with the late provincial Government.

According to the Golden, B.C., *Era*, a recent washout on the C.P.R. swept away sixteen bridges and culverts, including the Kananaskis, Devil's Head and Calgary bridges. The formation, it adds, was swept out for about twelve miles, and fully 500 eastbound passengers were detained at Banff, where they were cared for by the company. Canmore was flooded, Calgary, too, and at Anthracite horses in McNeill's mine were drowned and the mine filled.

The contract for building the East Richelieu Valley Railway, running from the town of Iberville, Que., to Lacolle bridge, a distance of 23 miles, as been awarded to J. L. Comte, of Montreal. The work will be finished this fall. There are no bridges of importance on the line, which has been subsidized by both the Quebec and Ottawa Governments to the extent of $8,500 per mile. Philip Roy, advocate, of Montreal, is the president of the company.

While at Golden, B.C., recently, General Manager Whyte, of the C.P.R., stated that it had been found necessary for the better working of the Rocky Mountain section between Golden and Laggan, to make Golden the divisional point, and to establish workshops there Consequently, the workshops will have to be removed from Donald, part going to Revelstoke, and the remainder to Golden. Car repairing shops will also be built. It is understood the C.P.R. shops at Canmore will be moved east to Calgary.

A Grand Trunk special train with the passengers from the Boston express, has made a remarkably fast run from Montreal to Sarnia. The train was running to make the connection with the Grand Trunk Chicago express, and left Montreal at 12.50 midnight on the 16th ult. Toronto was reached at 9.05 a.m. on Friday, and Sarnia tunnel at 12.48

in the afternoon. The entire distance, 503½ miles, was covered in 11 hours and 58 minutes, the time between the two points being cut down 2 hours 17 minutes.

A CABLEGRAM from London states that the capital of $400,000 has been subscribed for the Cassiar Railway, in the Cassiar district, in northern B. C. The company are working under a provincial charter which gives a lease of 700,000 acres of land, and rights to all minerals, including gold and silver, found therein. Parties connected with the Transvaal mining enterprises are behind the company, and it is expected it will lead to a large development of the rich Cassiar district, lying as it does between the Kootenay and the Yukon gold fields on the north.

C.P.R. stock has advanced from 46 in April to 72½ at the end of July, and no doubt it will go above this figure if the increased dividend, which has been unofficially announced, is declared in October next. It was in 1892 when the stock went to 90, and the earnings were away up. However, the returns are all right for the last six months. The net increase in the receipts for the six months ending June 30th reaches $558,000 over the same period of last year, so that there can be no difficulty about the increased dividend when the money is already earned to pay it.

IT is said that if the Klondike excitement continues the C.P.R. will extend the Calgary and Edmonton branch to Athabasca Landing, thus reducing the land route from that point to Fort Mackenzie near the mouth of the Mackenzie River, to one portage of less than twenty miles. It is stated that by a direct route from Edmonton the Landing can be reached by forty miles of track, but, as it is not probable that the Saskatchewan can be crossed at Edmonton, the impression is that from fifty to sixty miles of railway will have to be built.

THE contract for the Ottawa and New York Railway from Cornwall to Ottawa, about 52 miles, and the link on the American side of the river, which, with the Northern New York Railway, already built, will complete the connection with the Delaware and Hudson Company, has been let and work will begin as soon as the line is finally located. Two parties of engineers have been at work from both ends of the line and have nearly completed their survey. The contract calls for the completion of the line between Cornwall and Ottawa within 90 days from the time of breaking the ground. The scheme includes the bridges across the St. Lawrence from the main shore, a short distance above the town of Cornwall, to Massena Point, New York State, crossing the main line of the river to Cornwall Island, thence across the south channel to the American shore.

THE annual union meeting of the Brotherhood of Locomotive Engineers of North America was held in Windsor, Ont., July 14th and 15th. The gathering, which was held last year at Ottawa, is more of a social than of a business nature, but in spite of this fact there are about 300 delegates with their wives and daughters in attendance from all parts of Canada and the United States. Among the Canadian delegates present are : Chas. Clarke, London ; Jas. Duffy, St. Thomas ; W. H. Anderson, Moncton, N.B ; J Adams, London; Henry Wheatley, Montreal ; Jas. Currie, Smith's Falls ; Thos. Mans, Hamilton ; C. Lulunireve, Montreal ; W. Newcomb, Hamilton ; M. Lenahan, London ; W. Burnip, St. Thomas; J. Neilson, Albert McGuire, Toronto ; G. A. Kantley, Mandon, N.B.; R. G. Morris, Brockville ; J. F. Drummond, Palmerston ; H. Stagg, Ottawa ; Thos. Bruce, Point Edward ; H. Clendennen, Ottawa ; P. Endrock, Stratford ; W. C. A lison, Lindsay ; W. H. Paisley, Brockville ; W. Newcomb, Hamilton. The morning session, which was secret, was presided over by Grand Chief Arthur. The principal topic of discussion was one which for years has engaged the attention of all classes of organized labor, namely, the confederation of railway labor organizations. The discussion of the subject was spirited throughout, but it is understood that no definite action was taken. At 11 o'clock a civic deputation, consisting of Mayor Davis and Ald. Byron, Bell, Connolly, Duck, and Carney, arrived at Laing's hall, where the sessions are being held, and presented to Chief Arthur an address of welcome. This was replied to in a felicitous manner by Mr. Arthur, who in a few well chosen remarks thanked the deputation for its welcome. This ended the morning session, and after luncheon the ladies of the party were taken for a ride on the river. Another secret session was held in the afternoon, the subject discussed being on much the same lines as at the morning session. In the evening the delegates were entertained at a concert given in their honor at the Opera House. Among the speakers were Mayor Davis, William McGregor, M.P., and M. K. Cowan, M.P. for South Essex. The morning's session of the 15th brought the meeting to a close. The only officers of the brotherhood in attendance are Chief Arthur and Grand Secretary W. B. Prenter, who is also treasurer of the Order.

Personal.

THE assistant city engineer of Toronto, Charles E. Rust, has been appointed on the council of the Canadian Society of Civil Engineers, in place of the late Alan McDougall.

WM. H. DERRY, of Kingston, has been appointed chief engineer of the Kingston Penitentiary in succession to James Devlin, recently dismissed in consequence of the disclosures of the parliamentary commission.

JAMES HERRIOT, who has been for a number of years in the car department of the Grand Trunk at Toronto, has been transferred to the office of Mr. McWood, superintendent of the car department in Montreal.

BY an agreement made between the Quebec City Exposition Company and the Provincial Government, the company has engaged to erect its new buildings at Stadacona, and to contribute $6,000 to the erection of an iron bridge across the St. Charles River, in place of the Bickell bridge.

JOHN S. DENNIS has resigned his position as director of irrigation surveys in the N.W.T., and has accepted the office of director of public works under the North-West Government. He will take with him S. C. Wilson, who has been employed for some months in the irrigation office at Calgary.

IT is probable that in the retirement of P. S. Archibald, chief engineer of I.C.R., W. B. Mackenzie, of Moncton, second in rank to Mr. Archibald, will be promoted to the chief engineership. Mr. Mackenzie is a native of Barney's River, Pictou county, and an engineer of high standing.—*Halifax Chronicle.*

PROF. J. C. K. Laflamme, rector of Laval University, Quebec, left last month for Russia, to attend the international convention of geologists, at St. Petersburg. Prof. Laflamme is not only an eminent geologist, but is a man of varied scientific attainments, and Canada cannot be more ably represented than by him.

R. O. KING, B.A , Sc , of 503 Markham street, Toronto, lately referred to as having received the Whitney fellowship at Harvard University, has just received notice of the exceptional renewal of his science research scholarship from the British Association for a third term, which will be taken at Harvard University. The financial value of these awards for the coming term amounts to $1,050.

A JOINT board of surveyors has been appointed by the Governments of Canada, Ontario and Manitoba, to delimit the boundary between Manitoba and Ontario from the northwest angle of the Lake of the Woods, north to English River. E. Stewart, Rat Portage, Ont., Government mining agent, represents the Dominion Government. B. J. Saunders, C.E., Brockville represents the Ontario Government. The survey is necessary at the present time owing to the number of mining claims being taken up in the vicinity of this territory.

DANIEL HUNTER, formerly of the firm of Inglis & Hunter, boilermakers, Toronto, died last month, after a protracted illness, at the age of 57. He first settled in Campbellville, on coming to Canada from Ireland, and afterwards moved to Guelph, where he became a member of the firm of Inglis & Hunter. About fifteen years ago the firm came to Toronto. A few years ago Mr. Hunter left this firm, and since then has been connected with the Doty and Bertram companies. He superintended the putting in of the machinery on the "Corona," this being the last contract which he managed. He leaves a widow and family of eight children.

FEW railway officials in this country were more genuinely liked than J. J. Lanning, late assistant general manager of the Grand Trunk, and there was sincere grief when his death was announced in Montreal last month A biographical sketch of Mr. Lanning appeared in our issue of April, 1894, at which time he was promoted from the position of private secretary to the manager's assistant. He had enjoyed his promotion but a short time when he was laid up with consumption, from which he never recovered, though almost to the last he cherished the hope of soon being "in harness" again. It would have been hard to find an officer more faithful to his work than Mr. Lanning, whose career ran through the regime of four general managers. At the suggestion of General Manager Hays, Mr. Lanning compiled, during his hours of compulsory retirement, a history of the Grand Trunk system, which will, no doubt, see the light in due course, and prove interesting reading.

THE late A. L. Light, M.I.C.E., who died recently at Lac-a-la-Croix, Que., in his early youth, was employed in the construction of the Great Western Railway of Upper Canada. Subsequently he became a member of the Institute of Civil Engineers of London, and

entered into partnership with Mr., afterwards Sir James Brunlees, the celebrated Scotch engineer, who built the cantilever bridge over the Firth of Forth. Mr. Light was employed by the New Brunswick Government in building the European and South American Railway from Shadiac to St. John, by the Government of Canada in the construction of the Intercolonial, and by the Government of Quebec in completing the North Shore Railway, now part of the Canadian Pacific. His last engineering work was the Lake St. John Railway, of which he was consulting engineer for many years. Mr. Light was very highly esteemed in England and was selected by the late Duke of Newcastle as civil engineer in charge of the transportation of the troops to Bic, at the time of the Trent affair in 1861. He was chosen by Premier DeBoucherville, of Quebec, in 1877, to take charge of the railways in Quebec province, and he has resided in Quebec city ever since.

It is with feelings of the deepest regret that we refer to the death, on July 20th, of F. B. Robb, manager and secretary-treasurer of the Robb Engineering Co., Limited, of Amherst, N.S., which took place while he was bathing at McIvor's Point, Fox Harbor. Mr. Robb was not in particularly robust health at the time, and it is thought that the shock of entering the cold water was so great as to produce heart failure. From early in his life Mr. Robb had been connected with a successful business and was a leading member of the community in which he lived. In everything which concerned the public welfare and the moral advancement of the citizens he took a deep interest. He was chiefly instrumental in organizing the Boys' Branch of the Y.M.C.A., and it was while taking part in the out-door life of this society that he met his death. He was an active member of the Presbyterian church, was an elder and taught the young men's Bible class in Sunday school. Mr. Robb was an excellent musician, and when a leader was required to take charge of a musical programme, he was willing to give his talents to its aid. He was active in the formation of the local bicycle club and contributed largely to its funds. He was a member of the Good Roads Committee of the Canadian Wheelmen's Association, and at the time of his death was identified with many plans for the improvement of the country roads. Thus at every point in which Mr. Robb came in contact with the world his influence was felt for good, and no one could be more missed from his native city than he.

Marine News.

The Furness line steamer "Baltimore City" was wrecked in the Straits of Belle Isle recently.

The new steel barkt. "Hillside," owned by W. L. Lovitt, Yarmouth, N.S., recently arrived at that port.

The new Star line river boat, which has been in the process of construction for several months at McGuiggan's ship yard, St. John, N.B., was successfully launched last month.

The new D. A. R. steamer "Prince Edward," recently launched at Hull, is 700 tons register, with twin screws. She cost over $200,000, and is to be a sister ship to the "Prince Rupert."

The incorporators of the Rainy Lake Navigation Co. are: Geo. H. Bertram, Toronto; W. Ross, Rat Portage; G. A. Graham, A. Thompson, D. C Graham and J. T. Horne, Fort William. Capital, $150,000; chief place of business, Rat Portage, Ont.

In commenting on the novel features of the yachting and fisheries exhibition at the Imperial Institute, London, England, the *Yachtsman* says: "An oil launch, exhibited by Murray & Williams, of Montreal, apart from the points of detail, which we must describe on another occasion, seems calculated, from the manner in which it is prepared for exhibition, to teach even old stagers on this side a lesson or two, and should bring home the fact that white flannels are not so necessarily entirely out of place on a small steam yacht as some would have us think."

Electric Flashes.

The officers of the West Kootenay Light and Power Co. are: Oliver Durant, president; J. B. McArthur, secretary; F. Paul, treasurer.

Waterloo, Ont., is now lighted by electric light. The plant supplied Wm. Snider & Co. by the W. A. Johnson Co., Toronto, is affording every satisfaction.

The Brantford, Ont., Electric and Operating Company have been awarded the contract for wiring and installing an electric light in the main building at the Asylum for the Blind, Brantford, by the Ontario Department of Public Works.

The Royal Electric Co. have the contract for lighting the buildings and grounds of the Montreal Exhibition which is to be held from 19th to 28th Aug., and have a large number of men on the grounds.

The Bell Telephone Co is building a new exchange in Sherbrooke, Que. It is of pressed brick, with terra cotta facings about 26 x 45, and three stories high. It will be equipped with the most modern switchboards and will be ready for occupation about December next.

The Sherbrooke Street Railway Company has closed a contract with the Jenckes Machine Company, Sherbrooke, Que., for a 45-inch Crocker turbine, with tubing and wheel cases complete, horizontal setting, for direct connection to generator, which is being furnished by the General Electric Company.

A company is formed to build a telegraph line from Dyea to Dawson, Alaska, with a branch to Juneau. It is the Alaska Telegraph and Telephone Company. The directors are C. W. Wright, Theodore Richart, D. E. Bohenon, J. W. Wright and J. F. Fassett. The capital stock of the organization is $250,000, of which $100,000 has been subscribed by the directors.

The town of Lachute Que., population about 1,700, has an electric light system, operated by Simpson & Boyd, under the superintendence of Henri Tessier. They have a 30-h.p. water power and run 350 incandescent lights. Houses are lighted at 1½ cents per light per night. The consumer pays for installation, and may find his own lamps if he chooses. Accounts are payable monthly.

A St. Catharines despatch of July 9th says: "The well-known car manufacturers, Patterson & Corbin, have been in an exceedingly unfortunate position lately. Their shop has been closed for a few weeks, and a Hamilton bailiff is in charge. Yesterday afternoon the place was to have been put up at auction to satisfy a claim, but Bailiff Boyle stepped in on the behalf of Collector McGibbon, and the sale was put off."

The Montreal Belt Line, the new electric railway, has been formally opened by a band concert, pic-nic and fireworks at Bout de l'Isle, a village at the foot of Montreal Island, forming the present terminus of the road. The road has been excellently equipped by the Canadian General Electric Co., and is very popular with the citizens. The line makes a junction with the city system at Maisonneuve, and is 12 miles long.

The Canadian Power Co., referred to last month, is proceeding with work at Niagara Falls. The plans on file at Ottawa call for a canal 4,000 feet long, 15 feet deep, and 200 feet wide at the bottom, running from Chippewa Creek to the head of Dufferin Islands. The *Globe* says: "The company's organization is held in the background for a time, and the only known representatives are Banker R. Paine, of Niagara Falls, and Arthur C. Dennison, of Philadelphia. The company, according to Mr. Paine's statements, will develop 40,000 horse power at once, and about one-fourth of this will be for direct power use for mills, while 30,000 horse power will be developed in electrical form and transmitted."

The water was let into the head race of the big works of the Lachine Rapids Hydraulic Co. on the 31st without any ceremony, but the formal opening will take place somewhere about Sept. 1st. In the meantime the wheels and four of the twelve dynamos will be operated for 30 days by the contractors before the company takes them over. The company have issued a circular stating that they are prepared to furnish light and power to all comers, and claim that their power will be the cheapest in Canada. They will furnish light at ½c. per hour, but do not give figures for power. There is likely to be keen competition between this corporation and the Royal Electric Company, who supply most of the light and power to Montreal.

At the annual meeting of the Royal Electric Co. last month, the old board of directors was re-elected, and Hon. J. R. Thibaudeau was re-elected president, and D. Morrice vice-president. The annual report shows that the company has now $1,810,444 invested in machinery, plant and patents; it has $200,000 stock in the Chambly Mfg. Co., and $184,909 in outside plants, etc. These items, with goods manufactured and in process, make the total assets $2,978,095. The net profits (after deducting $43,245 for interest and fixed charges) for the year were $200,634, or 13.38 per cent. on the paid-up capital. Adding $75,000 as premium on the sale of new stock, the profits would be over 18 per cent. on the capital. The company are now working actively on the electrical equipment required for the generating station at Chambly and the receiving station in Montreal. The building of the dams, power-house and waterworks is well under way, and in a few months the company will be able to deliver on its lines in Montreal electric power generated at Chambly, and to give its customers the benefit of the reduction in cost to be derived thereby without impairing its own earning powers.

During the past year the Royal Electric Company, of Montreal, have been busy replacing all the old step-down transformers in this city with new ones, suited for the low-frequency alternating current which they are now supplying for incandescent lighting. Last summer the alternations were about 15,800 per minute, while this year they have been reduced to 8,920. This change of frequency has had the effect of so much reducing the "back kick" in the iron of the transformers used last year, as to cause them to draw a large amount of current, and consequently render them liable to burn out; hence the replacing with new ones. Alternating current motors have also had to be re-wound to enable them to run on this circuit. The first means employed to adapt high-frequency motors to the low-frequency was to simply place a small kicking coil in the circuit, but this method has been abandoned, as by far the best results are obtained by re-winding. This has to be done with smaller wire and nearly double the number of turns. We have seen a fan motor wound for the 104 volt high frequency (which is still supplied by the Citizens' Light and Power Co.) run splendidly on the 52 volt low frequency. In all probability the 104 volt circuit will soon be changed from a high to a low frequency, when all transformers on the line will have to be changed in the same way as the Royal Electric Co. have been doing.

Industrial Notes.

Lindsay, Ont., recently ordered a road roller and other good roads machinery.

The J. A. Sayward Lumber Company has decided to build a saw mill at Nelson, B.C.

The new match factory at Buckingham, Que., is reported to be doing a good business.

The Frost Wire Fence Co., of Cleveland, O., contemplate starting a branch factory in Ontario.

City Engineer Beaudry of Sherbrooke, Que., is preparing plans for a new system of waterworks.

The Northern Elevator Company is building a thirty thousand bushel elevator at Regina, N.W.T.

The Rathbun Company, Deseronto, Ont., is erecting a large lumber shed on its dock at Picton, Ont.

W. H. Kelly, Buckingham, Que., is building a new steam saw mill of a capacity of 50,000 feet per day.

A large pulp mill will be, it is said, built at once at Escuminac, Que., on the Baie des Chaleurs Railway.

A new Catholic church is to be erected in Barford, Que. The contract has been let to Paquette & Godbout for $14,800.

Extensive additions and improvements will be made to the Russell House, Ottawa, this summer, at a cost of about $12,000.

Jas. A. Simpson, formerly engineer at the Berlin, Ont., Water Works pumping station, has been succeeded by Wm. Collard.

The Arrow Milling Co, Birtle, Man., has made a contract with Stuart & Harper, Winnipeg, to overhaul and improve their mill.

A large number of grain elevators are being erected in Manitoba this year, and the aggregate capacity of the province will be increased over 25 per cent.

The Granby Rubber Co.'s box factory is now turning out 500 cases a day. The Robb Engineering Co. equipped the power. The factory is 36 x 84 feet.

C. J. Robertson, printers' machinery and supplies, 12 Phillips square, Montreal, will make an interesting display at the approaching exhibition in Montreal.

John M. Moore, civil engineer, of the London, Ont., waterworks staff, has made a report to the town council of Ailsa Craig, Ont., on their proposed waterworks scheme.

At the last regular meeting of the Brockville, Ont., branch of the C.A.S E., it was decided to hold the annual convention in Brockville, Thursday and Friday, the 19th and 20th August.

J. R. Booth and G. A. Mountain, C.E., engineer of the C.A.R. system, have been in Parry Sound superintending the erection of a one million bushel grain elevator in that town.

The Hamilton Smelting Works is sub-letting work, such as unloading and loading cars, and so forth. P. C. Peterson, ex foreman at the works, has been awarded three contracts.

Peuchen & Co., acetic acid manufacturers of Toronto, Ont., will establish a branch at North Tonawanda, N Y. The firm has leased the old buildings of the Spang Manufacturing Company.

The town of St. Mary's, Ont., through the medium of W. K. McLeod, secretary of the Board of Trade, is investigating the question of putting in a system of waterworks for the town.

Rudolph Herring, the New York engineer, has returned to Winnipeg to complete his investigations as to the best source of the city's water supply. He is said to favor artesian wells.

The sum of $1,800 was allowed the Gartshore-Thompson Pipe and Foundry Company for its loss by fire a few weeks ago. The loss was much greater, but the foundry was not fully insured.

The Jenckes Machine Company, Sherbrooke, Que., has just completed the balance of the sawmill machinery for the Montague Paper Company, Lake Megantic, which expects to start its new mills at once,

Harrison Bros. have let the contract for the erection of a 75-barrel flour mill at Holmfield, Man. Stuart & Harper, of Winnipeg, who represent the Stratford Mill Building Company, have the contract.

The Three Rivers Iron Works Company has been awarded the contract for the laying of mains for the waterworks and sewerage system of Renfrew, Ont., for $51,874. The stand pipe, pumps and plant will be awarded as a separate contract.

The Cooper Machine Company, Limited 92 Adelaide st. east, Toronto, report a good demand for their "Imperial" gasoline engine, and have recently made shipments to Bracebridge, Ont., Goderich, Ont., and Pawtucket, Rhode Island. They are increasing their facilities by the addition of larger machinery of the latest design. The firm will make an exhibit at the Toronto Industrial Fair.

A new industry for Guelph, Ont., is the Guelph Linseed Oil Company, Limited. This business will be carried on in a portion of the building occupied by the Guelph Flax Mill Company, and will be run in connection with the present business under the management of S. J. Taylor. The company will manufacture linseed oil, oil cake, flax meal and green tow, and will give steady employment to about 20 men.

Three new bridges have recently been completed at the Record Foundry and Machine Co.'s works in Moncton, N.B They are for College Bridge, Blackville, N.B., and Campbell's, near Nauwigewauk, N.B. The Campbell bridge consists of a single span of 240 feet in length. The College bridge consists of two spans, each of about 200 feet. The Blackville bridge is smaller, being a single span of about 200 feet.

It is understood that the Minister of Railways and Canals has authorized the construction of a new bridge to take the place of the present bridge over the Lachine canal at Seigneurs street, Montreal. The new bridge will be large enough for street car tracks as well as vehicle and foot passenger traffic. A new bridge may also be built over the canal at the foot of Atwater Avenue, which divides the city from St. Henri.

The three sets of plans for the water and sewage systems of Nelson, B.C., prepared by Messrs. Cummings, Coyle and McCulloch, have been accepted by the council, and each competitor was awarded $200. The reports favor Anderson creek as a source of water supply, and also agree as to the site for the reservoir. The estimated cost is between $1,900 and half that sum. A. L McCulloch has been appointed engineer in charge with a salary of $200 per month.

The work of restoring the malleable works is now in full swing, says the Whitby *Chronicle*, and will be pushed to completion as rapidly as possible. Jas. Gall has the contract for the stone and brick work. Don Valley pressed brick will be used for the front wall, and Whitby brick for the balance of the work. John Sykes & Son have the contract for woodwork. Goldie & McCulloch, of Galt, will supply the engines. It is expected that the works will be restored by September 1st.

Marsh & Henthorn have succeeded to the foundry business of the Geo. T. Brown Manufacturing Co., Ltd., Belleville, Ont L. W. Marsh has been accountant with the Geo. J. Brown Co. for about four years, and W. H. Henthorn has been mechanical superintendent for that company for about nine years. The new firm has already supplied three steam hoists to Wm. Gibson, M.P., for use on the Victoria bridge at Montreal, and in his quarries, and has several large orders on hand.

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20,000 feet 3-in. Boiler Tubes; 20,000 feet 4-in. Boiler Tubes, large quantity Steam Pipe 1-in. to 9-in.; large stock second-hand Rails; Pulleys, Hangers, Shafting, Valves, Gauges, Hercules Babbitt Metal, Solder, etc.

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The Canadian Engineer

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAPTER III.

CURVES—(*continued*).

ARTICLE 8—VERTICAL CURVES.

Wherever there is a change in the rate of grade there must be a vertical angle or a vertical curve. If this change is slight, less, say, than $\frac{3}{10}$ feet per 100 feet, no need exists, either on construction or afterwards, of doing anything more than to let the trackmen put in a slight curve by eye, but when the change is of considerable magnitude, care should be taken, both for the sake of appearance and also for safety, that a regular vertical curve unites the two grade lines.

In the past, in America, this has not been often done. If ascending and descending grades were to be united, a short piece of level grade was inserted at the summits and in the depressions; anything further was, curiously enough, relegated to the track gang as being a refinement unnecessary for a civil engineer to bother with; the track or section foreman, with greater appreciation of the real need for a regular increment of change from one grade to another, did the best he could and put in vertical curves by eye, which moderated the ill-effects of such neglect. Wellington has ably dealt with the subject, at length, from the standpoint of the link-and-pin coupler, and demonstrates that the vertical curve which is needed, theoretically, is one which will change the rate of grade from the front to the rear of the longest trains run over the road by an amount not greater than the grade of repose (the grade of repose is that grade down which a train will just keep moving under its own weight, and is about $\frac{6}{10}$ per cent. for loaded trains at a speed of 25 miles per hour, and increases with the speed). He reasons thus: Taking the train as a whole, each car will momentarily crowd toward the one in front of it, and so on throughout the whole length of the train, putting it in a state of compression, with slackened couplers if the grade resistance at the front of the train is enough greater than at the back end to exceed the grade of repose. This is based on an assumption of uniform engine power, and should the engine driver increase speed just at this instant, when everything is slack, the tendency will be to create severe jerks and oscillations causing derailments. This reasoning refers entirely to a grade depression, whereas at a summit the reverse will happen and the couplers will be momentarily strained much more than normally. From these premises we can see that the vertical curve at summits may be arbitrary in amount and much sharper than in depressions. Probably a change in rate of grade of $\frac{2}{10}$ per cent. for each 100 feet is not excessive, and may be inserted either as a complete curve joining the ascending and descending grades (see Fig. 8), or if the summit level is long it may be divided into two portions (see Fig. 9). When, however, a descending grade is to be

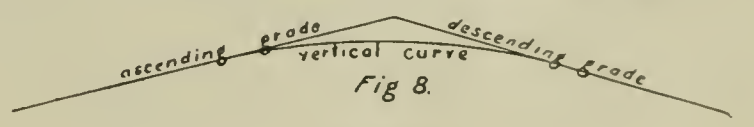


Fig 8.

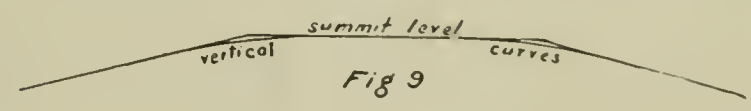


Fig 9

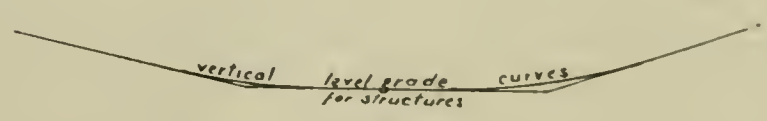


Fig. 10.

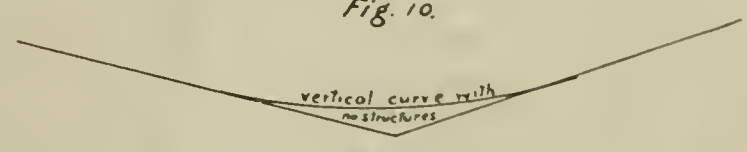


Fig. 11.

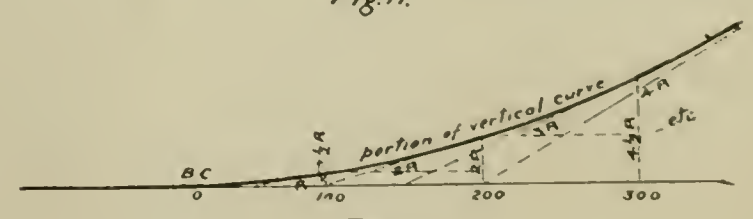


Fig 12.

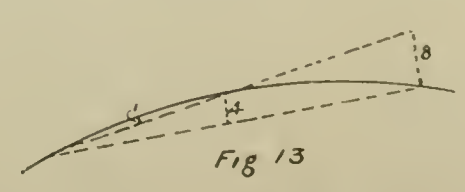


Fig 13

united to a level or ascending grade, an accurate calculation should be made for reasons already given. For in-

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

stance, supposing that the longest train on the road will be 500 feet (engine and 14 cars), then

$$\frac{\frac{5}{10} \text{ per cent.} \times 100}{500} = \frac{1}{10} \text{ per cent. change}$$

per 100 feet will be the amount strictly demanded for complete safety on a road of the given length of train using link and pin couplers. But as automatic vertical plane couplers, with practically no slack, come more generally into use, which is only a question of a few years, the need for such extensive curves will not be imperative, and a vertical curve changing more rapidly will answer fully, when a longer curve is difficult to obtain. Usually, however, a level grade between the descending and ascending grades is required, because a structure should always be placed on a uniform grade from end to end, and as they are usually in the depressions, this limits the vertical curve in such cases to two short pieces joining the level grade to the others. (See Fig. 10.) If there is no break in the embankment a continuous vertical curve is much better from every point of view, and should be put in as in Fig. 11.

On roads having only light grades, and consequently heavier and longer trains, the rate of change in depressions will be very small, and circumstances will determine whether the full amount can be put in without excessive cost; but with light grades and easy vertical curves, the distance which the middle of the curve will rise above the point of intersection is small. It may be calculated, in any case, in the same manner as the middle distance in horizontal circular curves, if the vertical curve is treated as a circle, or if treated more precisely as a parabola, it may be stated at once as half the distance which the apex is from the middle of a cord drawn from one end of the vertical curve to the other, this being a fundamental equation of the parabola.

(*a*) Treating the vertical curve as an arc of a circle, calculate first the permissible change in grade per 100 feet divide this into the total change of grade, giving the total length of curve, $\frac{1}{2}$ of which will be on each side of the apex of grades; then the position of the curve for each 100 feet relatively to the tangent lines may be obtained graphically on a large scaled drawing, or calculated more precisely as in ordinary horizontal circular curves.

(*b*) Treating the vertical curve as a parabola having a constant rate of change of direction per 100 feet, is more precise and more convenient. Calculate first the length of curve, which will be the same as in (*a*), and then proceed as follows: Let the change of grade per 100 feet = R. Then referring to figure 12—, the departure of the curve from the tangent will be $\frac{1}{2}$R, 2R, $4\frac{1}{2}$R, 8R, $12\frac{1}{2}$R, ... etc., till the middle of the curve is reached, after which the distances from the second tangent will recede . . . . $12\frac{1}{2}$R, 8R, $4\frac{1}{2}$R, 2R, $\frac{1}{2}$R, to the other end. It will be seen that by the latter method the elevations are always in even units or portions of units, and the rise of the curve above the tangents is given almost by inspection; for convenience the length of a vertical curve should be fixed at the nearest *even* hundred feet, so that the curve may be divided into two equal parts of exact hundreds in length. Such vertical curves, with their elevations once established, will be no more difficult to place on the ground and build to than a succession of straight lines with abrupt changes in grade, and will give a track safer in depressions, having better drainage in summit cuts, and better in every respect, but increasing the cost of the road-bed slightly.

Art. 9.—Horizontal Circular Curves.

It is not necessary to treat here of the mathematics of the circle. There are several engineering field books which have considerable space devoted to methods of placing curves on the ground under ordinary or exceptional circumstances. Some of these books also contain, in addition to ordinary mathematical tables, tables of external secants and of sub-tangents for each degree of curve, and for each interval of one minute in the total intersection angle; these books are great time-savers in field operations, and should always be used.

In placing curves on the ground, it is preferable to establish the two tangents first, intersect them and measure in the BC and EC from the intersection or apex; then the curve can be run in from either or both ends and any error minimized. With very long flat curves on unstable ground, it may even be preferable to fix the middle of curve from the apex by measuring in the external secant, and then run the curve in from the ends and middle; the method sometimes adopted of running a curve in from the BC, and deflecting on to the second tangent at the EC, is very liable to establish it erroneously.

Another very important point is the method of keeping curve notes. The vernier should always read half of the total deflection of the curve from the BC up to the point on the curve toward which the telescope is pointing; this is a constant index of the position of any point. This method necessitates loosening the vernier-plate at each set-up and re-setting it to read the index reading of the back-sight; but it has the all important feature of enabling a transit to be set up at any point on a curve, and being sighted to any other point with a certain knowledge of what the vernier reading should be. Curves can be run in backward as easily as forward. Any other method of keeping notes will be found, in the end; less reliable and convenient. Whenever curves are sharper than 4° or 5° it is better to put in stakes every 50 feet even on easy ground, as the difference between the length of chord and curve for 100 feet measurements would be considerable; it is also convenient for cross-sectioning. In running in sharp curves, particularly curves having a large intersection angle, the greatest care is necessary in the chaining; poor results in checking up at the EC are usually traceable to the errors in measuring the subtangents or the curve itself.

It is often necessary to replace stakes that have been lost, or to put in intermediate stakes on curves without the aid of a transit; whenever this is the case it is valuable to remember the following formula, which is approximately true for all curves usually used on steam railways:

It is $O = .218\ N^2 D$ ....(11)

Where O = offset from middle of a chord to the curve (in feet)

N = length of chord in 100 feet.

D = degree of curve.

Or, if simpler, remember that the offset from the middle of a 100-feet chord on a 1° curve is .22 feet, and that

(1) Offsets vary directly as the degree of curve.

(2) Offsets vary as the square of the length of chord, which is true up to 200 or 300 feet chords.

(3) Offsets, inward to a curve, from a prolonged chord are 8 times the offsets from the middle of the same length of chord outward to the same curve. This is illustrated in Fig. 13.

Circular curves are in general use on railways, but there have been isolated attempts at using the parabola, which have not been found satisfactory The idea involved in its use was to have a curve of easy radius at the ends and sharper in the middle, but the train did not travel steadily, being in a constant state of change from beginning to end of curve. It has been found from the very

first days of railroads that an annoying and dangerous jolt, sidewise, took place as a train either entered or left a curve, and the parabola was a first or rather a mistaken idea as to remedying this evil.

Instead of this, the concensus of opinion has fixed itself on the use of the circular curve, but with the modification of the use of easement curves at each end of it to join it on to the tangents in such a manner as to modify or wholly dissipate any disagreeable shock which would occur if the curve were to change instantaneously to a straight line. In the past the trackmen have been allowed to introduce these easements themselves in an approximate and makeshift manner, but at present there is a growing feeling that an accurately calculated and placed easement curve is necessary, especially as passenger speeds are becoming higher. Easement curves have been used for many years in Europe, and are becoming quite common in America.

CONDENSERS.*

BY E. J. PHILIP, TORONTO.

The condenser may be said to have the inverse relation to the steam that the boiler has, for as the boiler raises the temperature of the water and increases its volume, the condenser reduces the temperature and volume. The boiler converts the water into steam, and the condenser reconverts the steam into water. The advantage of running condensing instead of exhausting against the pressure of the atmosphere is explained by reference to the principle by which the maximum efficiency of heat engines is calculated. For example, suppose two engines exactly alike and each driving the same load, each working with steam of say 60 lbs. pressure absolute, one working with a condenser and the other exhausting into the air, suppose one engine expands down to 3 lbs. absolute, the other to 2 lbs. above atmosphere or 17 lbs. absolute, the relative efficiency of the two engines may be expressed as follows: The temperature of steam at 60 lbs. absolute is 292.7, that of steam at 17 lbs. absolute is 219, and of 3 lbs. 141.5.

$$\frac{292.7 - 141.5}{461 + 292.7} = \frac{151.2}{753.7}$$

while that of the non-condensing engine is

$$\frac{292.7 - 219}{461 + 292.7} = \frac{73.7}{753.7}$$

or in the ratio of 73.7 to 151.2, or as 18 is to 37. From a mechanical point of view the advantages are more apparent as illustrated by an indicator diagram, for it enables us to reduce the back pressure from, say 2 lbs. above to 12 lbs. below the temperature of the atmosphere.

Condensing allows us to make use of much higher grades of expansion than is possible by non-condensing. The condenser itself is an apparatus into which the steam is discharged when it has done its work, where it comes into contact with a jet of water, or else with a large surface one side of which is kept cool by contact with water. The steam entering the condenser is instantly condensed, giving up its heat to the water. The result would be a practically perfect vacuum only for the fact that the feed water contains air which the steam gives up during condensation, and causes a back pressure on the piston. An air pump is attached to a condenser to pump out the air and the water of condensation, and in the jet condenser it has also to pump out the injection water and the air it contains.

There are many forms of the different types of condensers. The best known type is the jet condenser, once used almost universally when pressures did not exceed 35 pounds. It consists essentially of an air tight chamber into which the exhaust steam passes from the cylinder after having done its work. It is met on entering by a jet of water caused by the inrush of water through holes or slits in the pipe placed across the opening, or by many other spraying contrivances. If the water enters through holes in a shower, it mixes mechanically with the steam; if it enters through slits, it causes the water to enter like broad, thin sheets, and the cooling is done principally by surface contacts. In either case the result is the same: the turning of the steam into water, and it falls to the bottom of the condenser and is pumped out by the air pump.

It might be supposed that the mere turning of the steam into water, thereby causing it to occupy less space, will cause the vacuum. It does, but to so slight an extent that unless some other means to maintain it were provided the condenser would be useless, for the reason that water readily absorbs air when exposed to it, and gives it up again on being boiled. The feed water contains air, which becomes mechanically mixed with the steam in the boiler, and passes with it through the engine to the condenser, where it is freed from it when the steam is condensed, and remains as cool air. In the jet condenser the cooling water also contains air, and under the partial vacuum and the temperature of the exhaust steam it readily gives some of it up. The engine has only to make a few strokes without the air pump, when the air will have accumulated so as to raise the pressure to that of the atmosphere, and although the condenser may be kept cool there will be no vacuum. Now the water that has accumulated from the steam being condensed, might be arranged to run away by gravity; it is only the air that is of necessity pumped out, and hence the pump, although pumping both air and water, is rightly named the air-pump. The jet condenser has been made in many different shapes. The essential feature is that the inlet for the steam prevents the water running back to the engine, in case of flooding. A good arrangement for mixing the steam and water is to have the bottom so formed that the water will all drain into the air pump. Condensers are made to suit the various conditions and positions. In marine work they are made to suit the relative positions of engine and hull, and was often a part of the engine frame.

The columns of vertical engines were used for this purpose until the practice was forbidden by the Admiralty, but they are so used in some cases yet. The capacity of the jet condenser is usually one-third the capacity of the engine, and should not be less than one-fourth or more than one-half. The objection to a large one is, besides its extra weight and first cost, the longer time required to form a good vacuum. The objection to a small one is the liability of flooding. The quantity of injection water varies, and it depends on the temperature of the steam and its weight, also the temperature of the injection water and the water in the hot well.

The feed water is usually taken from the hot well, and there is an advantage in having it as hot as possible without impairing the vacuum. Therefore there should be just sufficient injection water used to cool the steam down to the required point to get a good vacuum with a jet condenser; 24 inches is a good vacuum; 25 inches is the most economical point. The temperature due to 24 inches vacuum is 140°. In actual practice the temperature of the hot well varies from 110° to 120°, but it can be got up to 130° with great care. To calculate the quantity of injection water per pound of steam to be condensed, let T be the total heat of the steam; let T be the temperature

*A paper read before the C.A.S.E. convention at Brockville.

of the cooling water and t the temperature of the hot well, and Q the quantity of cooling water per pound of water in the steam.

Then $Q = \frac{T - t}{t - T}$. This is the number of lbs. of cooling water for each lb. of water in the steam. Example: Find the amount of injection water required. Exhaust 19½ lbs. injection water, 60; hot well, 110:

$$\frac{1182.1 - 110}{110 - 60} = 21.44, \text{ or } \frac{1114 + .3 \times 227 - 110}{110 - 60} = 21.44.$$

Pressure began to rise above 35 lbs.; the jet condenser was abandoned, and the surface condenser began to take its place. One of the principal causes was on account of the feed water carrying so much salt, which, as the water in the boiler was evaporated, became so saturated as to be eventually deposited on the plates, and thus destroy the boiler. The only way to avoid this was to blow off some of the brine and feed in some with less salt. The hot water blown away caused a large loss of heat, varying according to the different degrees of saturation. The maximum density is three times that of sea water. The loss was generally from 12 to 15 per cent. of the fuel supply. In order to stop this loss it became necessary to feed the boilers with fresh water. This could only be done by keeping the steam and condensing water separated, and this led to the surface condenser. Another reason was that in order to effect any considerable economy in the engine, it became necessary to raise the steam pressure. Now if the pressure be raised above 35 lbs., the temperature of which is 280, the sulphate of lime in the sea water is deposited in hard insoluble layers on the heating surface, and destroys its efficiency. To obviate this, it became necessary to use fresh water, which was another reason for the surface condenser.

The amount of water required with a surface condenser is from 30 to 40 per cent. greater than with a jet condenser. In experiment, it was found that sheet copper backed by water condensed from 21 to 50 lbs., and under special conditions 100 lbs. per square foot per hour. It is usual, however, to allow only 12 to 13 lbs. per square foot per hour, for ordinary compound engines. In a surface condenser, the circulating water must be kept in constant circulation to realize the greatest efficiency by keeping up as great a difference of temperature between the two sides of the plates. The air pump, with the surface condenser, is much smaller than with the jet; but the condenser is much larger, heavier and more costly than the jet.

The amount of cooling surface allowed per h.-p. varies from 1¾ to 3 square feet, but is usually 2 or 2½. The surface used is now always brass tubing. In former times copper tubing was used, as it was such a good conductor of heat, and had the qualities to resist the varying strains and temperatures, and it could be drawn out very thin; but it was found that the acids from the fatty matter used in cylinders dissolved some of the copper, and formed soluble copper salts which was fed into the boilers with the feed water, and did great damage to the boiler. This gave the surface condenser a set back, as the saving was offset by the extra wear and tear on the boilers. To prevent this, the tubes were coated with tin inside and out, and this partly prevented the trouble, but not altogether. Brass tubes were tried, and after getting the proper mixture proved a perfect success. Much has been said about the corrosive action of distilled water; but most of the trouble from pitting and corrosion in boilers and their fittings using distilled water has been found to be the action of the water on something else, and the matter formed is what does the damage to the boiler.

Before closing with condensers, I will say a few words about the necessary complement of the condenser, the air pump, of which there are different types. The most efficient, the writer believes, is the single acting vertical pump, having valves in the bucket, as well as foot and delivery valves. This is a very familiar form of pump. Another is the double acting, made both vertical and horizontal, having a piston with foot and delivery valves at each end. In most of the stationary plants the air pump is of this type and driven by an independent steam cylinder. This is a good arrangement, as a vacuum can be produced before starting the main engine. The disadvantage is, it is the most wasteful way of operating the pump. In marine engines the pump is usually driven from the cross-head and is generally single acting. The advantage of this arrangement is the pump is driven at least expense for power. The efficiency of the single acting pump is due to its certainty of taking the water through the bucket valves, and to the certainty of the valves closing, due to their position; also the valves are always flooded with water and the clearage may be reduced to a minimum.

The size of the air pump can be calculated theoretically, and it has been found that the single-acting pump, working under favorable conditions, has an efficiency of .6 and varies to .4. The efficiency of the double-acting pump may be taken as from .5 to .3. The size may be taken as three times what theory demands. With a surface condenser there is also a circulating pump to circulate the water through the tubes. In stationary work, the pumps are arranged with the steam cylinder in the middle, with the air-pump at one end and circulating pump at the other, all on one rod. In marine work some use an independent pump, either an ordinary double-acting plunger or a centrifugal pump. Others use a single or double-acting pump driven from the main engine. The capacity of the circulating pump may be calculated the same way as the air-pump. The centrifugal pump has many advantages as a circulating pump, if the lift is not great. It has no valves to interfere with the flow of water or get out of order. Being worked by a separate engine, it can be started before the main engine, and keeps the condenser cool while warming up. Having an independent engine, the quantity of water may be varied to suit conditions, the power to run it varying in proportion. The supply of water is continuous, thereby avoiding all shock to the condenser and piping, and its efficiency is greater for low lifts than any reciprocating pump.

Another type of condenser I will just mention is the ejector condenser, which is perfectly satisfactory under certain conditions. The principle on which it works is the same as the ejector, but the water should have a small head to make it work satisfactorily when as good a vacuum can be maintained as with any other type. The water should not be over 60°, although it has been used at a higher temperature. The rise in temperature is usually about 20 or 25°, but in experiments it has been raised 60 to 64 with a final temperature of 120°, but under these conditions the vacuum fell considerably. In this type the power to run the air pump is saved; these condensers have also been made to lift their own water, but under these conditions they are unreliable.

THE Carlisle Packing Company, Victoria, B.C., is now exporting canned salmon in tin cans which have a porcelain lining. If these cans can be produced at a reasonable price, their use should enormously extend the Canadian trade in canned fish, fruits, etc., as in this way the goods could be indefinitely preserved without danger of becoming poisoned by the corrosion of the can.

For THE CANADIAN ENGINEER.

THE MINERALS OF NEWFOUNDLAND.

BY AN OLD RESIDENT OF ST. JOHN'S.

Newfoundland as a field for legitimate mining, which, with intelligent management and moderate capital, would return handsome dividends, seems to have been hitherto almost entirely overlooked. In the December issue of THE CANADIAN ENGINEER, 1895, there were notes from the pen of the late Geo. Spotswood, C.E., on the petroleum fields which he had then partially examined, and of which a few months prior to his death he had been in charge, and had successfully developed. Unfortunately this was at the cost of a valuable life. Anxiety and exposure in getting the first well completed and the second started hastened the course of a disease he had contracted, and which resulted fatally in November, 1896.

The geology of the field as determined from his partial examination is shown in the report to the company which is operating the claim located by him in October, 1894: "The geological formation belongs to the Quebec group—consisting of limestone, limestone conglomerates, shales and sandstones, with dips from 30° to 80° and strikes varying from 220° to 250°."

An analysis of the crude oil was made by J. T. Donald, of Montreal, on September 27, 1894, and was as follows:—

Specific gravity	.885, or 28 B.	Burning oil..	14.50 per cent.
Water	traces.	Heavy or lub.	82.50 "
Gasoline	none.	Solid res	3.00 "
Naphtha	"	Sulphur	.098

This analysis was made from crude oil gathered from the surface depressions; when the wells were sunk it was found that the oil at 1,000 feet was much lighter, and gave a higher percentage of illuminating oil, as shown by the following report of Rufus Merrill, who refined a sample of the crude.

"Color, dark olive green; gravity, 36° B. at 60° F. Odor, aromatic. Yielded by destructive distillation.

Naphtha	7	per cent.
Ill. Oil	56	"
Lub. Oil	34	"
Coke	3	"
	100	"

"This oil belongs to the aromatic petroleums and is of the paraffine series; the products of distillation are of bland and pleasant odor, easily refined, and yield more readily to and require less acid and alkali than any of the oils found in the United States. The illuminating oils are high fire test water white, and burn with a clear lambent flame of great brilliancy and less tendency to smoke than the best United States oils. The crude oil is very free from grit and foreign substances, and with proper reduction would make a first class natural lubricant; finally, there is no known field which to-day produces an oil of equal quality."

The territory appears to cover about 250 square miles, but beyond the wells sunk by the Newfoundland Oil Company, which are producing, and one ten miles further north, there is no development. An English company is negotiating for the Newfoundland Oil Company's property, but whether they will finally close the deal cannot be stated; it is to be hoped that either an English or Canadian company will secure the territory, and not let the United States refiners step in, as usual, and gather the financial honey which our people should get. If the Newfoundland Oil Company does not sell it will probably refine the oil on the spot, and ship to England; they are on the seaboard, and 6½ to 10 miles of pipe will put the product of the wells at tide-water.

Asbestos properties on the west coast must very soon be a factor in the asbestos market. On a claim which the writer knows there is an inexhaustible quantity of low-grade and a very large quantity of high grade ore, which can be mined and sold, on account of the favorable situation, for very little more than it costs to mine in Quebec. I am aware that the Quebec miners are sceptical about the asbestos in Newfoundland, but some day they will have an object lesson that will open their eyes to the facts in this case.

The minerals, etc., so far found in Newfoundland, in economic—and probably economic—quantities, are gold, silver, lead, iron (both magnetic and hematite), coal, copper, nickel, asbestos, gypsum (no deposit in any known country so large), marbles of the most beautiful kinds, chromic iron, manganese, and molybdenum.

Mining in that country has suffered from two things—ignorant and most unskillful management and over capitalization, for both of which the English operators are principally to blame.

THE INDICATOR.*

BY G. B. RISLER, LONDON, ONT.

The indicator is an indispensable assistant to the engineer, and of late years it has become evident that intelligent and wideawake steam plant owners recognize the necessity for such a valuable instrument, and they are also appreciating the services of the engineer who is competent to use it properly.

The indicator diagram is actually the only means of showing on paper what really takes place in a cylinder. To read an indicator card correctly is not an easy matter, and in order to be able to do so, considerable study and practice are necessary. The handling of such a delicate instrument requires a great deal of care, and sometimes considerable skill and ingenuity must be employed in making the needed attachments. By its use many stumbling-blocks will be removed, while the calculations and geometrical work which the engineer will be impelled to make in connection with it will lead to the acquisition of a good general knowledge of the whole subject. Careful consideration of the diagrams from different engines, under varied conditions, cannot fail to lead to thought and investigation. A general knowledge of the law of gases (especially Mariotte's law) is needed, and a study of physics, mensuration and mechanics is most beneficial.

In order to determine the most economical plan of operating a steam plant, many tests are made. Such tests, if properly conducted, are valuable, and are much to be appreciated by steam plant owners, who will find it to their interest to give every encouragement and assistance to the engineer along this line. The diagrams traced by the indicator pencil will vary widely, and depend on the condition of the different engines from which they are taken, and it therefore becomes necessary to know how to interpret these variations correctly. This information the engineer can only acquire through the processes of reasoning and hard study. In attaching the indicator considerable skill is sometimes needed, and circumstances must determine what plan can best be employed. The reducing motion must be such that it will give to the paper barrel in its reduced scale an exact reproduction of the movement of the piston.

Examine your indicator, and see that every part of it is moving freely, has no lost motion, and is well oiled. A

*A paper read before the Canadian Association of Stationary Engineers' Annua Convention, Brockville.

cord that will stretch is to be avoided. Good judgment is required in putting the proper tension on the paper barrel spring for differently speeded engines. The indicator springs should be tested occasionally to see if they agree with a standard steam gauge of known accuracy. Do not use too light a spring for the pressure. If the instrument is a reliable one, and the necessary precautions have been taken in every particular, the diagram will then show you the pressure acting on the piston on both sides, and at any part of the stroke during one revolution of the engine, and that is all it will do. Knowing the scale of the spring, it is an easy matter to determine the pressure at any point of the stroke. This little tell-tale instrument will leave on a piece of paper a good deal of information, providing the atmospheric pressure line is properly established on the diagram. It is of the greatest importance that this line be drawn correctly, as it is the neutral line of the diagram, and from it all pressures above and below must be determined. After removing the card from the paper barrel, it is advisable that all data be made on it as complete as possible, and then will its study be pleasant and profitable.

The following terms are used in speaking of the different lines and curves: The atmospheric line, vacuum line, admission line, steam line, exhaust line, counter pressure line, compression and expansion curve. The beginning and termination of some of these lines are called points, and their continuation indicates periods in the stroke of the piston. Technical terms for pressure are as follows: Boiler pressure, absolute pressure, initial pressure, cut-off pressure, terminal pressure, back pressure, and mean effective pressure. The mean effective pressure is what we must find in order to calculate the indicated horse-power of the engine, and the indicator card is the only means of getting it correctly.

Having once established the mean effective pressure from the diagram, the work done in one stroke, in foot pounds, can be calculated as follows: Multiply 144 by the mean effective pressure, and by the cylinder volume in cubic feet, displaced by the piston. Two simple and easily remembered rules for finding the indicated horse-power when the mean effective pressure is known, are as follows: 1. Multiply the mean effective pressure by the cylinder area in square inches and by the piston speed in feet per minute, and divide by 33,000. 2. Multiply the mean effective pressure by the length of the stroke in feet, by the area of the cylinder in square inches, and the number of strokes per minute, and this, divided by 33,000, will equal the indicated horse-power. From the foregoing it can easily be seen that the indicator is invaluable in determining the work done by an engine.

But this is not all, by any means. An analysis of the expansion curve, which requires considerable knowledge and accurate working from a geometrical and arithmetical standpoint, is of great value, and the nearer the actual expansion curve of the diagram approaches the theoretical (often called the equilateral hyperbola), the greater will be the economy. A considerable deviation from the actual and the hyperbolic curve impels the engineer to think and to reason out the cause. A leaky piston, a leaky steam valve, re-evaporation in a cylinder, or a leaky exhaust valve—all these tend to bring about an expansion curve, which is not in accordance with the law of gases laid down by Mariotte, viz., that the volume should vary inversely as the pressure. This, of course, is to some extent an impossibility in an engine cylinder, owing to loss of heat and leakage. Nevertheless, diagrams have been taken from steam engines which are a credit to the engineer, as well as to the engine builder, and are almost identical in the expansion curve to the hyperbola. It is not advisable to come to hasty conclusions in regard to the expansion and compression curve, as well as other lines, because the laws of nature can have quite an influence in this respect, owing to the surroundings and conditions under which a steam engine may be working. The engineer well knows that dry steam should be furnished to an engine; therefore, it is reasonable to state that the steam boiler at times can be held responsible for a diagram which does not approach the ideal. If the steam pipe leading to the boiler is too small in diameter, the indicator diagram will give an indication of it, but this should be verified with the diagrams taken direct from the steam chest or the steam pipe. The indicator card will furnish the means of knowing how the steam is distributed in the cylinder. If the valve gear is not properly working the card will show it. With calculations from the diagram we can find with what sort of economy, mechanically and thermodynamically, the engine is working, and if underloaded or overloaded the engineer will be in a position to advise his employer exactly what changes should be made in order to insure greater economy in fuel. The steam line may show considerable initial expansion or loss of boiler pressure, and the back pressure line can point out excessive resistance to the piston. Both cases are evidence of wasteful expenditure of steam.

Economy to the engineer means keeping down the fuel account, having small bills for repairs, little or no loss from shut-downs, regular speed, and the least possible loss from deterioration. The engineer must be guided by circumstances, and if he finds himself confronted with conditions that render the attaining of strict economy impossible, he then can only make the best of bad surroundings. Steam engine economy is made up of many factors, and it is to be hoped that the endless study and exertion on the part of the intelligent and ambitious engineer will be appreciated by the employer.

It is my belief that many steam plant owners or managers are willing to assist the engineer financially in obtaining such an instrument as the indicator, as well as other most valuable appliances which would serve as aids in many instances to the greatest economy.

My employers, The *Advertiser* Printing and Publishing Company, of London, have recognized the wisdom of this, and assisted me to the extent of $50 in purchasing an indicator in 1893, and also obtaining for me in 1896 a free engineer's scholarship with the International Correspondence Schools in Scranton, Pa.

For THE CANADIAN ENGINEER.

COMPOUND, DIAGONAL PADDLE ENGINES.

On page 127 is shown the side elevation and plan of the engines of the steel paddle steamer being built by the Polson Iron Works, of Toronto, for the Pembroke Navigation Co., from the designs of Arch. P. Rankin, consulting engineer, of Toronto.

The hull, which is of steel throughout, is 125 feet long, 21 feet beam, 7 feet 6 inches deep, and 4 feet 9 inches draught, and the estimated speed is 14 miles per hour.

The engines are of the compound, direct-acting, diagonal type, which has of late years become very popular for paddle steamers, its chief advantages among others being that the weight is better distributed along the keel, and the stresses set up by its action are chiefly in a fore and aft, and downward direction, and therefore easily resisted by the natural structure of the vessel. Moreover, with this class of engine the chief working parts are in full view of the engineer from the starting

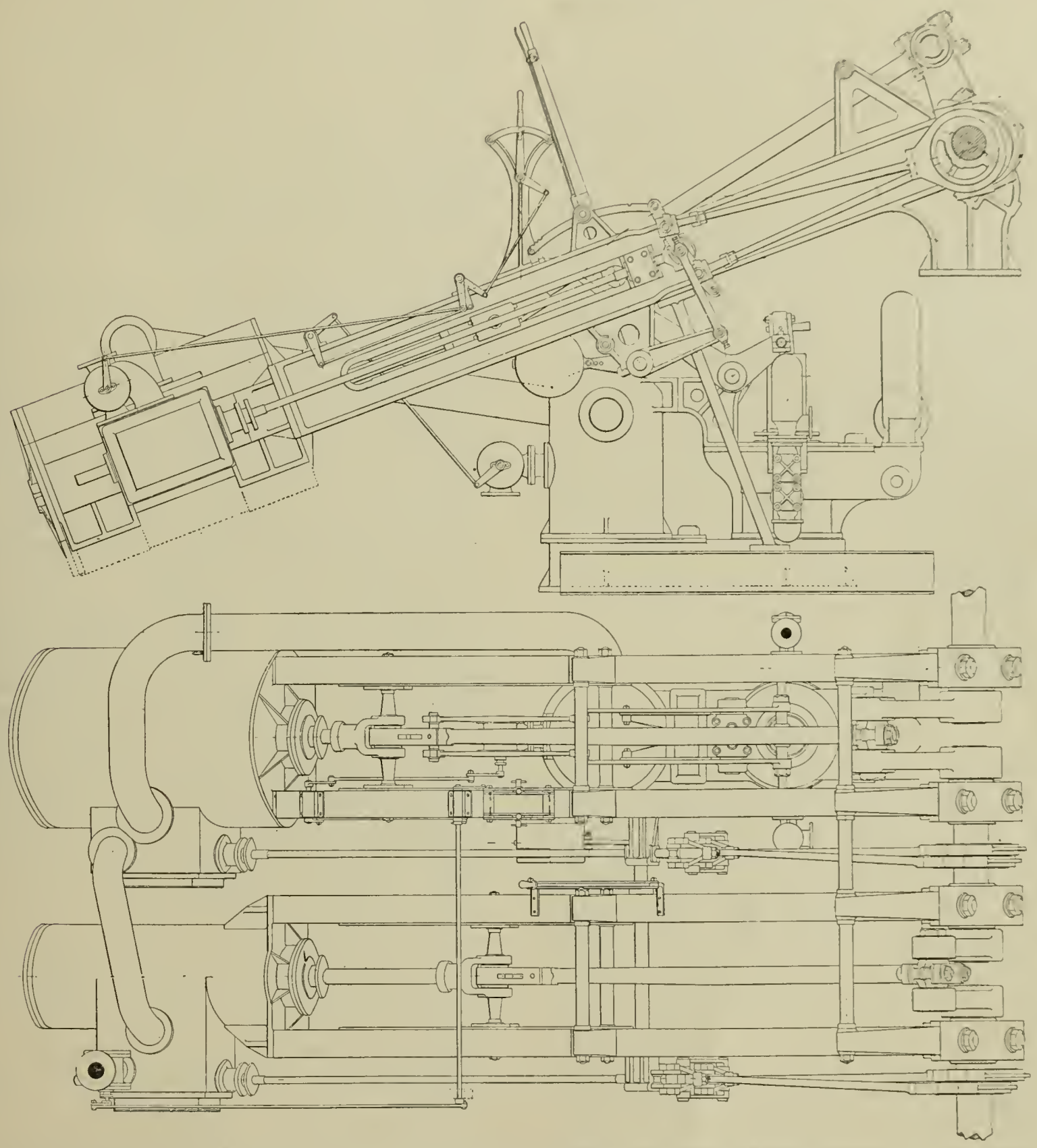
platform, and are easily got at for adjustment and repairs.

The high and low pressure are respectively 17 inches and 34 inches diameter, with a piston stroke of 48 inches, connected to each other only by the exhaust pipe. Both cylinders are supported on a diagonal stool built of steel plate and angles, riveted to the floors of the ship, with gusset plate extensions so as to form a transverse girder under the cylinders. Slide valves are fitted to each cylinder; the H.P. being an ordinary single ported, and the L.P. a "trick" valve giving a double opening to steam.

The pistons are hollow box castings fitted with two "Ramsbottom" rings each, the piston rods being of steel, secured to pistons by taper and nut, and keyed to the crossheads, which are steel castings. The cast-iron slippers work in guides in the main frames, and are fitted with large adjustable bronze plates.

The connecting rods, which are 10 feet, or two and one half times the stroke, between centres, are of malleable iron, parallel in diameter for one half their length, and tapering towards crosshead end, and are fitted at ends with brasses of large surface, which are easily adjustable.

The cranks are steel castings keyed to intermediate shaft, at right angles to each other, with H.P. leading, the crank-pins being secured to inner cranks by taper and nut, and free to some extent to move in outer cranks between steel plates. The shafting is of best hammered scrap, the main bearings being eight inches diameter by 10½ inches long, while the outboard bearings are nine inches diameter by 16 inches long. The main bearings, four in number, are formed with the main frame castings, and are supported on a shelf piece the width of the engine hatch athwart ship, which shelf is carried by a bulkhead extending across the ship almost directly under the centre line of shaft. The shelf is also supported, and the bulkhead stiffened, by fore and aft plates and gussets, under the centre of each bearing; this construction giving great transverse stiffness under the shaft, and ensuring the bearings being held in perfect alignment.



INCL. COMP. ENG. 17 & 34 x 48. SCALE 1 INCH = 1 FOOT. GENERAL SIDE ELEVATION AND GENERAL DRAWING PLAN.
BY A. P. RANKIN.

The main frames are of cast iron, of open girder section, suitable openings for the crosshead guides being formed in them, and the brackets for cross stays and reversing shaft bearings cast on. They are secured to cylinder ends by fitted bolts and studs, and each frame is supported at about the centre of its length by a diagonal stay, the bottom end of which rests on a steel I beam riveted to the floors of ship. The frames are connected together in pairs above and below the guides by stays

and distance pieces, and are tied by a continuous cross stay above the four main bearings.

The valve gear is of very substantial design of the double bar, link motion type, all wearing surfaces being large and adjustable. The eccentric rods are of wrought iron, with T end for attaching to straps, and fitted at link ends with cast steel forks and adjustable brasses. These rods are comparatively short, and the valve spindles are correspondingly long, thus making the parts to be moved by the reversing lever lighter, and facilitating the handling of the engine. The reversing lever is 7 feet long, stands 5 feet above the starting platform, and has a travel from "full ahead" to "full astern" of 4 feet 6 inches. The quadrant with the lever for operating the throttle and injection valves, is fastened to one of the main frames at a convenient distance from the reversing lever.

The condensing apparatus is placed below the L.P. engine, resting on the ship's floors. The air pump is vertical, single-acting, fitted with bucket and delivery valves, and connected to the jet condenser by a channel plate, in which is located the foot valve. From the ends of the air pump crosshead, the feed and bilge pumps are driven, the whole of the pumps being operated through wrought-iron levers and drag links from the crosshead end of L.P. connecting-rod. A bilge injection valve is fitted so that, when necessary. the bilges may be pumped out by the main engines through the air pump. The valves of all the pumps are arranged so as to be easily accessible.

The paddle-wheels are radial, 14 feet effective diameter, each wheel having 14 floats 4 feet 6 inches wide.

Steam is supplied by two steel boilers 54 inches diameter by 20 feet long, of the locomotive type, placed forward of the engines. They are built for a working pressure of 130 lbs. per sq. inch.

The estimated horse-power of the engines, at 40 revolutions per minute, is 300.

For THE CANADIAN ENGINEER.

SEWAGE DISPOSAL.

BY WILLIAM M. WATSON.

In previous articles on sewage disposal the writer described the International Purification System, which uses ferrozone for a precipitant and polarite for a filtrate. Compositions of the ferrozone and polarite used were also explained, and he commented on the cost and efficiency of the system. The Rivers Purification Company's system was taken up, which purifies sewage by carbonized refuse, such as vegetable garbage, excrements, etc., collected in towns, brought to a red heat in a muffled kiln and afterwards used to filter and purify the town's sewage. There was also a detailed description of the workings of the Bradford, Eng., sewage works, where a precipitant of milk of lime was used. The Amines system of using a mixture of herring brine and lime, the Conders process of using a solution of lime, and the native guano process were dealt with. All of these can be studied in the back numbers of THE CANADIAN ENGINEER.

I then stated that purification by land was impossible on account of the extreme climatic influences in this country, and even in a very mild climate such as New Zealand the land is often unsuitable. Irrigation lands should be gritty and porous to a depth, at least, of four feet, and should be well and carefully under-drained. It was formerly supposed that vegetation was the principal factor in the cleaning and purifying process. In summer, vegetation will extract the manurial constituents, and powerfully assist in destroying the bacteria. But careful experiments prove that farm land is really a process of filtering, and that the purification is effected by oxidation. Therefore, irrigation lands must have periods of rest to allow time to secure aeration, and should never be drowned or water-logged; and to prevent it doing so, provision should be made to store the sewage during storms or severe frosts. By having separate drains for the carriage of sewage the flooding can be avoided, but I see little chance of providing for long periods of frost except by going to the unreasonable expense of covering the irrigation land in winter.

If the land is composed of adhesive loam, light loam, or light gravelly soil, the whole of the organic matter contained in the sewage can be removed. The underdrains should be in short lengths, close together, say every two feet, and the discharge end terminate in an open channel, so that air could freely pass through them to the land. Nearly all public authorities owning irrigation works consider that an untrained farm laborer is able to manage the works, the result being that, say, the $100,000 spent in shaking up the land and underdraining is lost, because the land gets fat and useless, the drains are choked, and the sewage passes through untreated.

Broad irrigation is effected by running the sewage direct on to farm lands, and on account of the tenacity of soil in holding in suspense moisture, sufficient land must be acquired to allow one square yard to each two gallons of sewage discharged per day in dry weather. The land would sometimes absorb a great deal more, but it requires to have periods of rest sometimes for as much as a month, and it is unsafe to allow an average of more than two gallons per yard per day. The amount could be increased by doing some draining to draw off the moisture. The land on the slope of a hill is the most suitable; low, flat land that is often waterlogged is useless. In most places it will necessitate pumping the sewage to the hill top. There is no fixed rule how to proceed in distributing the sewage on the land. Generally shallow channels are cut by a spade, and the sewage drawn from the nearest branch. Broad irrigation on farm lands is feasible where the city is built on a hill and there is plenty of arable land that is situated below the level of the main outlet of the sewer, and the land itself is high and dry above the storm water mark of the nearest water course. But except the town is fortunate enough to have these requirements, the system, if adopted, is expensive, and can only answer for a makeshift, useful in dry weather.

The Government in Great Britain for the past fifty years has demanded that all sewage shall pass through land during the final filtering stage. It happens that the majority of large towns are built in hollows and low lands bordering on the water courses, and on the banks of navigable rivers or seas, and only high enough to secure a good fall for the drains above the high water mark, and they cannot possibly introduce a simple inexpensive gravitation sewage works; but where six feet in depth can be secured it can be accomplished, by the screening bank and roughing filter being on the same level, then letting the clarified sewage come from the top of the roughing tank on to the land, thus doing without any machinery or sludge presses. Twenty feet is about the depth necessary to provide for the proper arrangement of a good self-acting works; it then gives space for mixing the precipitants by water power, and of shaking up the sewage water by water wheel or turbine, and the first or roughing filter can work downward, the clarified sewage passing out at the bottom of the tank and over a water wheel or rough stones to give it another shake up, and aerate it, then run along box-made channels on to the bacteria filter, composed of

fine charcoal, etc., made by the Jaggers' kilns from towns' refuse or other suitable material.

Where it is necessary for the roughing filter to work by an upward flow to save pumping, and where there is under 10 feet of depth to work on, it will require an apparatus to clear the sludge settling at the bottom of the tank. Candy invented a revolving pipe to suck it out, which is clumsy, and expensive, and soon disarranged. There is another method simpler, cheaper and more efficient.

Every system of purifying sewage depends largely on the qualification of the manager and attendant for its efficiency. To properly manage a sewage disposal works requires a man with a thoughtful and creative mind, well-informed on most technical subjects, one who will sift things to the bottom, and who will take a lively interest in his work.

The judgment used in selecting employees for such important and responsible positions, means the saving or the wasting of a large amount of money, and the improvement or decline of the general public's health. In fact, the success or failure of many costly sewage works is due to the personal qualities of the manager.

We now come to the precipitants, and my experience with regard to them is that there is considerable humbug in connection with them. There is a great variety of sewage; one is dye-polluted water, that is permeated by strong chemicals. The chemicals and colors having got a good grip on the dye water, then a chemical or other substance must be employed to compel them to let go their hold, and allow the water to return to its pure state. There are at least one hundred different kinds of precipitants used in Great Britain, and I believe that in half the cases powdered clay would answer for the purpose of dividing the solids from the water better than the more expensive precipitants. Clay has been successful when the chemicals would not make any impression. If many of the marketed precipitants that have high-sounding names are examined, powdered clay, and sometimes charcoal, will be found to form a part of the mixture.

The art of purifying sewage is now being revolutionized, and if it were not that the British people are very slow to take up a new idea, the general use of precipitants in England would have been a thing of the past some time ago.

The Messrs. Jaggers showed the officials their invention of carbonizing town refuse and afterwards using the product for purifying sewage, and proved that they could secure the best effluent, but the Local Government Board refused to permit works to be constructed without using irrigation land for the final process of filtration. And as the towns did not wish having two methods, they were compelled to obey orders (except a few like Baildon, which risked having their own way), and take the method of land irrigation, and to prevent the land from getting too fat or dirty, they are compelled to clarify the sewage in settling tanks, using precipitants to be able to handle it quickly—which, when the cost is placed alongside the cost of the new idea, is often about 75 per cent. more. Strange to say, we find that those towns which have lately got sewage works in Canada have selected a system or a mix up of the parts of several systems that can hardly do good work. The effluent discharged from them is probably dangerous.

An effluent may appear clean after clarification and the solids have been extracted by settling tanks and precipitants, but they have only taken out what is chiefly offensive to the eye, viz.: manurial, fœcal, and heavy substances that do little harm until allowed to putrefy, but the chief reason for needing purification is still in the sewage water, held in suspension, viz.: albuminoids, ammonia, free ammonia, chlorine, alkalies, etc, which are all good in their proper place, but are decidedly in the wrong place when they are in water that may be used to water cattle and promote fish life.

There is a kind of sewage discharged by slaughter houses, wool and skin washers, and by large hotels or restaurants, that is heavily charged with blood, grease and fat. By using a precipitant of bisulphide of carbon it may be made to settle down; but when the sludge is put into a press only 23 per cent. of the moisture can be extracted and the sludge still remains a liquid. If it could be pressed clear of the moisture and made into a cake, it would be valuable for fuel and gas making. Even after clarification the whole of the fat is not removed, and when it passes to the filters, stops up the air cells of the filtrate, of course partly destroying the filter's purifying power. Slaughter houses and wool and skin washers should always be compelled to clarify their sewage before discharging it into the public sewers. In England there is a firm contracts to extract the fat for the right of taking it away for sale. Hotels and restaurants should have a grease trap connected with kitchen and pantry sinks, for grease is the worst enemy to sewage works and drains.

Those towns which have adopted the Jaggers carbonized refuse filters can dispose of greasy sewage without the use of precipitants, because coming on to the filters in a raw state, and having to pass down through a fine powdered charcoal, it leaves the grease on the surface, which in a short time covers the filter and stops the flow, when it can be scraped off, along with about two inches of the charcoal which has become contaminated.

Mr. Pasteur and Mr. Warrington both declared years ago that sewage contained the organisms necessary for its own destruction, and with the combined efforts of engineers, chemists and biologists it will soon be accomplished. They have proved that there is a great variety of minute organisms in sewage and land, and that in the colonies of bacteria there is a marked difference in their tastes and habits. Some are very dangerous to the public health, and must be destroyed or they will destroy us. On the other hand, there are other colonies that, so far as the public health is concerned, are harmless, but they kill and destroy the dangerous ones. On this account we are now making the friendly ones useful by setting them to destroy the dangerous ones. And it is now believed that ever since 1762, when filtering sewage was begun to be cleaned by passing it through land, that it has always been partly done by our allies the bacteria, and only very slightly by growing vegetation. We now are certain that the filtrate, whether composed of sand, rubble, spar, coke, coke breeze, carbon and iron-coal, charcoal, or charcoal made from refuse, that its value consisted only in its qualifications for becoming a comfortable lodging house to the bacteria.

Now the latest improvement is purification by bacteria filters, sometimes called purifying by microbes. In England there are about five small towns working on this principle of allowing the sewage to purify itself by natural processes. Each of the places do it by different ways, and patents are, I believe, placed on each method. Some use the settling tanks and precipitants; others make a darkened tank answer in place of a precipitant and settling tank, and another by passing the raw sewage through a roughing filter to clarify, then through the bacteria filter to purify. The advantages of the bacteria filter are that it eats up all the injurious matter and dirt except grit,

sand, etc , and by so doing does away with sludge and expensive machinery used for mixing precipitants, pressing, pumping, etc., and perhaps the greatest advantage is that the works do not require so much depth as the old complicated system.

So it seems probable that the sewage works of the future will have a roughing filter, and if sufficient depth of land can be secured the sewage will be run on raw from the sewer. Then it will pass through carbon of some kind or a substance of a similar nature; then out at the bottom and through troughs to the filter, where it will be split up and rained on to the filter in small streams. Each filter will contain over three feet in thickness of filtrate properly packed together, but in such a manner that the air can get through and supply the bacteria with the oxygen they always need to assist them to carry on the work of nitrification, and enable them to discharge the hydrogen that they manufacture.

If there is not sufficient depth to allow both filters to have a downward flow, the roughing filter must work with an upward flow, which will save four feet, and it may have a very simple contrivance attached to clear the bottom of sludge and bring it to the surface of the ground. To work a sewage business of this kind will cost very little, and the cost of land and construction will be small in comparison to that, for instance, of the Hamilton, Ont., stamp. The filters can be constructed so that they will filter 200 gallons of sewage per square yard per day, or if you choose to say cubic yard per day, for we should make the filtrate at least a yard deep.

The next point is what is the best material for use as a filtrate. The State Sanitary Board of Massachusetts at Boston has conferred a great benefit on the world by making exhaustive experiments into the sewage purification business, also into the habits of bacteria life and their use for filtering purposes. They used sand of various kinds, pebbles, broken stone, gravel and similar materials, but no carbon of any kind or charcoal. They showed us how the climate acted on the filtering material and what season of the year the bacteria works the best. The stony kind of material is, in my opinion, too cold. In England, coke or coke breeze has been the favorite filtrate for a long time. I used this material and it gave fairly good results, but we knew of nothing better then. Mr. Garfield, the manager for Wolverhampton, Staffordshire, England, happened to observe a very filthy stream run on to a heap of soft coal screenings, and he also observed that when it run out at the bottom of the pile it was equal to spring water. Being an intelligent man, he lost nothing by his observation, but quickly tested its purifying power in his sewage works, which went all right; so they use small coal for filtering at Wolverhampton. This find is almost as good as a Klondike to England, because they have hundreds of large pit hills composed of screenings, shale, etc., that they formerly could not sell.

Having no coal to spare in this country, and seeing that we burn the very dust, the find will be of no value, only in places where a coal mine is located. Professor Peat for a short time purified sewage with wood charcoal and secured a pure effluent, but the cost could not be tolerated. Benj. and H. B. Jagger, of the Rivers Purification Company, Limited, of Southport, Eng., have found a method of making a powdered charcoal from towns' refuse and garbage, which answered even better than wood charcoal, and supplies a material that suits better than anything else for the bacteria filter.

The idea that charcoal was the best filtrate is very ancient. Where the Jaggers system is used, as at Baildon, Yorkshire, Eng., and other places, a muffled kiln is built near the filters, and the excrements from privies, ashes, vegetable refuse, street sweepings, bad meat, or any offensive material is taken and tipped into the destructor or kiln, brought to a red heat, then withdrawn, cooled and riddled, and then used to filter the sewage. It has been shown that it is necessary when constructing any kind of a sewage or water filter to make a proper provision for the passing of air through the filtrate. If they succeed in being able to aerate a filter, and at the same time be passing sewage through it, then the sewage works will need very little attention after having been once started, and the cost of management will be reduced to a fraction, because the sewage will be continually running through and there will be no machinery or sludge to care for. There are two patents already out which profess to be able to meet this requirement. Mr. Lowcock has got a method of putting perforated pipes in the centre of the filtrate, connected with a fan blower that is driven by power got from the stream of sewage coming down the sewer to the works. The fan forces the air into the filters at a pressure of five inches of water. He proves that this supplies all the needed oxygen, and there is no need to stop the filter to aerate. In my opinion the method will stand improving, for if the filtrate is water-logged or immersed in water I cannot see how five inches of pressure is going to travel 18 inches, and should it travel upward it will never travel downward and aerate the lower half. I am quite aware that the most work is done in the first 12 inches of filtrate at the top, and on this ground it may answer.

There is another inventor who builds the filtrate on a grating, leaving an air space of about a foot between the concrete bottom and the bearing grate. In the walls of the filter tank he builds a quantity of air shafts and raises them to several feet above the filter level, then fixes Howarth screw ventilators. These being driven by the wind of course create a vacuum in the air space under the bottom of the filtrate, which causes a quantity of air to come down with the water, for in this case the filter cannot be water-logged or the air space at bottom would be choked. Of course the water or effluent, when passing out of the filter, is trapped to prevent air coming in that way. I believe this system will be improved on, especially when the Jaggers system is the filtrate, because having considerable heat at the kiln it could be utilized to increase the draughts without using ventilators.

There is another way to aerate which certainly gives plenty of air to the filter, but requires a great deal of machinery and attention and makes it costly. It is used by the International Sewage Purification Company, in England, but, I believe, not by their agent out here. They found that passing water through even polarite (which is composed of sesquioxide of iron, 53.98; silica, 15.10; magnetic oxide of iron, 19.19; protoxide of iron, 7.25; calcium oxide, 1.42; carbon, 1.80) did not purify the water when kept running, and the Government inspectors would not permit the effluent to be discharged. They have now altered their system, and the sewage is discharged suddenly on to the filters by self-acting valves and troughs which are constructed to hold the quantity necessary for one charge. It is thrown on quickly, so that the air contained in the filtrate cannot escape. The sewage settles down, forcing the air before it, and as it lowers below the surface, of course draws a fresh supply of air into the polarite. It takes under two minutes to spread the water on, and they allow eighteen minutes to pass out, and the polarite to get re-aerated, so the cycle takes twenty minutes.

It is estimated that one thousand population discharges 156 pounds of solids and 260 gallons of urine each day. It appears to me to be a wilful waste to have all that valuable manure converted into hydrogen, and blown away for every plant to share in it, when by spreading it on our land it would enrich the land and increase the crops.

Sewage that is allowed to stand and ferment as it is in the sewage irrigation works at Berlin, Ont., and which contains about the usual amount of organic matter per gallon, will give out $1\frac{1}{6}$ cubic inches foul gas per hour per gallon. This shows that irrigation works where the land is allowed to get waterlogged, as the land does in Berlin, is a menace to the health of the country.

The average composition of the sewage in the small towns of Ontario is about as follows, viz. :

Organic matter.....	.....27.72	grains to each gallon.
Nitrogen	6.21	" "
Phosphoric acid	1.57	" "
Potash, about	2.03	" "

When some of this weak sewage is placed under a powerful microscope it is shown to contain various dead and decaying matters, also multitudes of bacteria, but few of the higher class of microbes ; neither does the heavier sewage, and when a new bacteria filter is started it must be supplied with a sufficient number of colonies of the sewage destroying kinds. So in the first place it must be filled by an effluent running from another filter and allowed to stand for a time until the bacteria can sufficiently increase.

ROLLER BEARINGS.*

BY W. BAYLEY MARSHALL, M. INST. C.E.

The application of rolling motion to bearings has been rendered practical within the last year or two. The author referred to (*a*) the advantages which might reasonably be expected to accrue from the use of roller bearings, (*b*) the requirements of satisfactory bearings constructed on this principle, and (*c*) some of the results which have lately been obtained from the adaptation of such bearings to rolling stock and other purposes.

(*a*) *As to the advantages arising from the use of roller bearings.*—It is an interesting fact that although full knowledge has existed from the earliest days of the advantages of rolling motion when applied to tractive purposes, as shown by the use of wheels or rollers, for reducing the effort required to transport heavy loads, it is only within comparatively recent times that serious attempts have been made to substitute such motion for the ordinary rubbing or scrubbing friction between the axles or journals of such wheels or rollers and their bearings. If by the introduction of rolling motion between the journals and bearings of the rolling stock or between the wheels and axles of the road vehicles, as the case may be, a further and very considerable reduction in the effort required to move any given load can be obtained, and this at a comparatively small additional monetary expenditure, far outbalanced by the consequent economy, it would seem that such application must become general. The following are, amongst others, the principal advantages claimed for roller bearings : Great reduction in starting effort ; decreased tractive effort ; decreased revolving effort ; economy in lubrication.

The reduction in the effort required to start vehicles or shafts fitted with roller bearings, as compared with those fitted with ordinary bearings, is of such importance that if it were the only advantage it would warrant the necessary additional monetary expenditure. Although it is not claimed that the reduction in tractive force will be so large in proportion to that in starting effort, it must be remembered that this force is in application during the whole of the time a vehicle is running on level ground or ascending gradients ; this point, therefore, becomes of great importance when the total amount of work done is calculated.

The decreased revolving effort is of great economical value in all cases of heavily loaded shafting, as careful experiments have shown that the amount of power required to drive the main and counter shafts in workshops, all the tools being idle, amounts to as much as from 50 to 80 per cent. of the power required when all the tools are in full work ; these figures show that there is ample room for improvement in shafting bearings. The economy in lubrication is a considerable item, seeing that a perfectly constructed roller bearing does not require any lubrication but only sufficient oil need be applied to prevent the rusting of the various parts.

The various parts must be proportioned with reference to their relative movements, so that nothing but rolling motion takes place between the surfaces engaged. The bearing rollers must be kept parallel with the axis of the axle or journal upon which they run, that they must not be allowed to touch each other, and that they must be of sufficient diameter and length to bear the fatigue of the duty they have to perform. Adequate provision must be made to meet the end thrust, not only of the rollers, but also of the axle or shaft when revolving within a fixed bearing, or of the bearing itself, when revolving upon a fixed axle. The bearing must contain as few working parts, and these as simple as possible. The most important from a commercial point of view is that the bearings shall be produced at reasonable cost.

For many years the only successful application of rolling motion to bearings was the well-known "ball-bearing" so universally adopted for cycles, and although these bearings have been found most satisfactory when subjected to light loads, all attempts to apply them to heavy ones have, so far as the author knows, resulted in failure, these failures arising chiefly from the balls indenting the paths or races upon which they run. Directly this takes place the balls begin to lose their friction-reducing properties. If a semi-circular trough be constructed which accurately fits a ball, and after the ball is placed therein, one end of the trough is lifted until movement of ball takes place, it will be found that the ball moves by sliding and not by rolling ; this is indentation carried to its extreme limit. Another defect in the ball bearing is that the balls are allowed to touch each other, and as the touching points of any two balls are revolving in opposite directions, there must be a certain amount of scrubbing friction.

Improvements which have been made recently in the use of roller bearings are making their employment in general traction more common, and are seen on a number of English railways, on some of which the tests were made, from which the following data were compiled :

A passenger train of six carriages, fitted with roller bearings throughout, has been running for two years between Brighton and Kemp Town, with a total mileage of over 70,000, and has shown a saving of from $12\frac{1}{2}$ to 15 per cent. in the consumption of fuel, which saving has been obtained under most disadvantageous circumstances, inasmuch as the engine has to be kept in steam for about 16 hours per diem, whilst its actual running time is under seven hours.

A tramway car fitted with ordinary bearings and

* Abstract of a paper read before the Toronto meeting of the British Association for the Advancement of Science.

weighing 2 tons 15 cwt. was let loose from a point 56 feet up an incline with 1 foot 6¼ inches rise. It ran down this incline and 57 feet along the level line at foot of same, or a total distance of 113 feet. The force expended was therefore 6,160 lbs. falling through 1.521 etc., feet, or 9,364 foot-lbs. The average frictional resistance was 9,364 ÷ 113, or nearly 83 lbs., equal to 30.5 lbs. per ton. A similar car fitted with roller bearings being let loose from the same point, ran the full length of the level line available, namely, 320 feet, and had not then quite come to rest, the total distance traversed being 376 feet. The force expended was as above, 9,364 foot-lbs. The average frictional resistance was 9,364 ÷ 376 = 24.9 lbs., or about 9 lbs. per ton of load. A saving of 70 per cent. Relative starting effort of a tramcar on a gradient of 1 in 20, ordinary bearings 100, roller bearings 77, saving 23 per cent., ditto, ditto, on a gradient of 1 in 80, ordinary bearings 100, roller bearings 50, saving 50 per cent., ditto, ditto, on a gradient of 1 in 140, ordinary bearings 100, roller bearings 39.6, saving 60.4 per cent.—results which require no comment. Perhaps one of the most interesting amongst the general applications of these bearings is that of the big bell at St. Paul's Cathedral, "Great Paul," which with its headstock and other moving parts weighs nearly 25 tons, and which gave considerable trouble when mounted on ordinary bearings. The following results are instructive: When mounted on the ordinary bearings the bell came to rest—after the swinging effort had been discontinued—within one minute, when on roller bearings in 6 minutes 55 seconds, showing that the frictional resistance of the latter was only about one-seventh of the former, a result remarkably in accordance with the starting effort tests given under the head of "Tramways." With reference to the question of heating it is an interesting fact that there has not been a single case of a hot bearing in all the experience so far gained with roller bearings.

Although it is somewhat early to predict what the cost of maintaining these bearings will be, the results so far show that if they are constructed of suitable materials, it will be extremely low; 60,000 miles in railway work and over three years in tramway work, with but very slight wear are most encouraging. It has been found that polished compressed steel is the best material for the rollers, cast steel for the cases in railway and heavy shafting bearings, and hard cast iron for tramcar and other lightly loaded and slow-running bearings.

We have been compelled to hold over a quantity of interesting matter, including a report of the meeting of the British Association for the Advancement of Science, held in Toronto last month.

UNUSUAL MINING.*

BY J. T. DONALD.

Lac a la Tortue (Turtle Lake), 21 miles from the city of Three Rivers, on the Piles branch of the Canadian Pacific Railway, is a very curious iron mine, worked by the Canadian Iron Furnace Company, which operates a modern water-jacket furnace at Radnor, 10 miles distant. This lake is a body of water about four miles long by one and one-quarter miles in average width, occupying the centre of a large area of swampy land. The surrounding land is largely composed of sand formed by the wearing down of the Archaean rocks by glacial action. It is well known that decaying vegetable matter yields acids that dissolve the oxide of iron. Evidence of this solvent action of vegetable acids on iron are frequently seen in pieces of slate. The slate is colored by iron, but frequently white or light-colored spots occur. These are points where a leaf or a fragment of bark has been deposited with the fine mud, in which form the slate was deposited. The leaf or bark has decayed; the vegetable acids thus formed have dissolved the iron oxide to which the color of the slate was due, and of course a white or colorless patch is formed.

In the sandy area around Lac a la Tortue we find the most favorable conditions for the action of vegetable acids on iron oxide. The sandy land produces a rank vegetation, and its decay furnishes abundance of organic acids. These acids are in solution in the drainage waters, which on their way to the lake percolate through the sand. They thus come into contact with the iron oxide in the finely divided materials, dissolve it, and carry it along to the lake. Here a new chemical action comes into play. The solution of iron in vegetable acid (in which the iron is in what the chemist calls the form of a protosalt) is oxidized by the action of the air on the surface of the lake into a persalt, which is insoluble, and appears on the surface in patches that display the peculiar iridescence characteristic of petroleum floating on water. Indeed, not infrequently these films of peroxide of iron are incorrectly attributed to petroleum. These films become heavy by addition of new particles, they sink through the water, and in this manner, in time, a large amount of the iron ore is deposited on the lake bottom. It must not be supposed that the ore is deposited as a fine mud or sediment. On the contrary, in this lake ore, as it is called, we have an excellent illustration of what is known as concretionary action—that is, the tendency of matter when in a fine state of division to aggregate its particles into masses about some central nucleus which may be a fragment of the sunken wood, a grain of sand, or indeed a preformed small mass of itself. Precipitated in water, as our lake ore is, it of course has great freedom of movement, and we, therefore, find it in flat concretions, more or less porous and circular in outline; the general appearance amply justifying the term "cake ore," which is locally applied. These concretions vary much in size, some of them being no longer than mustard seeds, others 8 or 10 or more inches in diameter. Frequently the larger cakes are joined together and form masses looking not unlike batches of a certain kind of bun commonly exposed in the shop window of every confectioner, and made by coiling a strip of dough round and round a piece of itself.

The ore is not found over the whole lake bottom; it occurs along the whole margin, and also well out from shore where streams enter the lake, the distance of the ore deposit from shore depending, of course, upon the volume of water carried by the streams and the velocity with which it enters the lake. Certain strips of ore occur at a considerable distance from the shore, and in as much as 16 ft. of water. These deep-water, mid-lake deposits denote probably the courses of former streams which are now non-existent, owing to some change of level. The ore is extracted from this lake-mine by hand and by power; the shallow margins are worked by hand, while from the deeper parts of the lake the ore is raised by means of a steam dredge.

A short time ago the writer was instructed by the proprietors to make an examination of the lake-mine and report the quantity of ore in sight. From the description of the mine already given, it will be seen that the task allotted was a somewhat unusual one. A certain amount of planning and experimenting was necessary before any satisfactory method of getting at the quantity could be determined upon, but finally the following method was adopted, and found to work admirably:

A number of lengths of 1-in. gas pipe were coupled into one length of about 30 ft., and this, resting on the stern of a scow, was pushed down into the water until the end rested on the bottom of the lake. The scow was towed by a tug backward and forward over the whole lake. When an ore deposit was reached, its presence was indicated by the vibratory motion of the long pipe, caused by the end slipping from cake to cake of the ore. When no ore was at hand the end of the pipe slid smoothly along the firm sand, for fortunately nothing coarser than sand is found in the lake except ore cakes. When a deposit of ore had been located and its superficial extent determined as above indicated, the quantity of ore per square foot of each deposit was determined as follows: An iron tube about 2 1-2 feet in diameter was lowered from the side of the scow into the deposit and worked down until it passed through the ore layer into the sand beneath; then, by means of an implement like a telegraph spoon and by long handled tongs and grappling irons, all the ore within the area of the tube was brought up to the deck of the scow, where it was examined and

* From *The Engineering and Mining Journal.*

weighed. This was done at several points in each deposit, and having already determined the extent of the deposit it was an easy matter to estimate the ore in sight in each.

By this method it is believed that a very reliable estimate of the quantity of ore in the lake was obtained ; certain it is that the estimate made by the writer differs materially from those that had been made by other means. It must be added in conclusion, that this lake-mine is something like the widow's cruse of oil of which we read in Holy Writ—the supply is being constantly renewed. Vast amounts of iron still exist in the surrounding sands. Vegetable acids are formed from the decay of each year's vegetation, and each year the drainage carries into the lake and deposits there a large amount of iron. This is no mere theory ; one can actually see the deposition of the ore along the margin, and, moreover, it is found in actual working ; if a certain spot be worked out it will in a few years again yield ore in paying quantity.

HOW TO MAKE A SIMPLE STEAM CALORIMETER.*

BY M THOMAS FULLAN.

In these latter days of keen competition, it is desirable to take every advantage, and to correct all sources of loss from whatever cause. The fact that many boilers, particularly when forced or overworked, produce wet steam, is well known, but the amount of this moisture, or even the fact of its existence, is not always easily determined.

Many engineers have not access to the expensive instruments for determining the same, and in view of this last fact, I herewith submit a short description, with sketches, of a very simple "throttling" calorimeter, which any engineer may construct for himself, at the nominal expense of a few pipe fittings and a steam thermometer, which may be purchased for a couple of dollars.

Fig. 1 shows the calorimeter assembled in position for use, connected to a steam pipe; when possible, it should be connected to a vertical pipe, as shown. The body of the instrument may be made of a 1-inch T fitting, into the top of which is screwed the bushing, *B* (Fig. 2) ; into the bushing, *B*, is fitted the thermometer tube, *T*, which is made of brass, turned down, as shown, sufficiently thin to readily

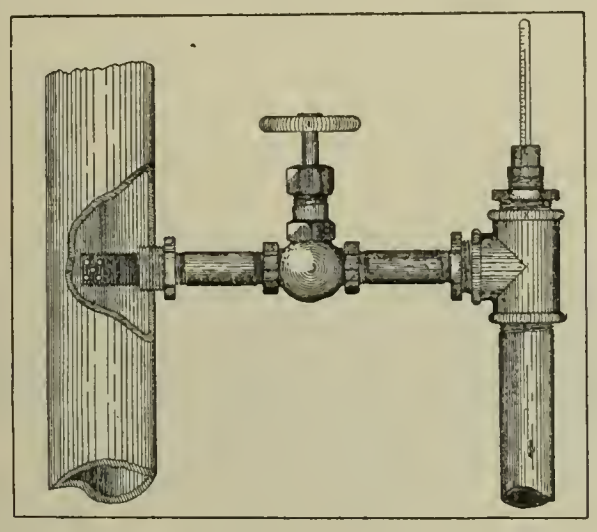


FIG. 1.

transmit heat, and the mouth of the tube is somewhat cupped. The steam pipe *S*, made of ½-inch pipe, is threaded sufficiently long, so that after having been screwed into the bushing, *D*, it will accommodate a ½-inch cap, *C*, which is screwed on the end, making a steam-tight joint with the bushing, *D*. Into the centre of the cap is drilled a small hole, about $\frac{1}{8}$ inch in diameter, countersunk on both sides, the function of which is to "throttle" the steam.

Care should be taken in obtaining, as near as possible, the best specimen of steam in the supply pipe, so it is advisable to connect up, as shown in Fig. 1, by inserting the feed pipe, *S*, the end of which is perforated, into the centre of the supply pipe. If it is simply screwed in, as is ordinarily done, some of the condensed steam, which invariably exists, would, in trickling down the side, enter the calorimeter and cause an error. The exhaust pipe, which leads from the bottom of the instrument, may be of any convenient length. Fig. 2 shows other views of the thermometer tube and throttling nozzle.

This type of calorimeter, termed "throttling," was developed by Prof. R. C. Carpenter, of Cornell University, and the principle upon which it operates is as follows :

Some of the heat contained in high pressure steam is liberated when the pressure is lowered, and that heat is utilized in evaporating any water the steam may contain, and in raising the temperature of the steam above that due to its pressure. Thus, for example, the total heat in 1 lb of steam at 80 lbs. absolute pressure is 1,177 B. T. U. (British Thermal Units), and that in 1 lb at 20 lbs. absolute pressure

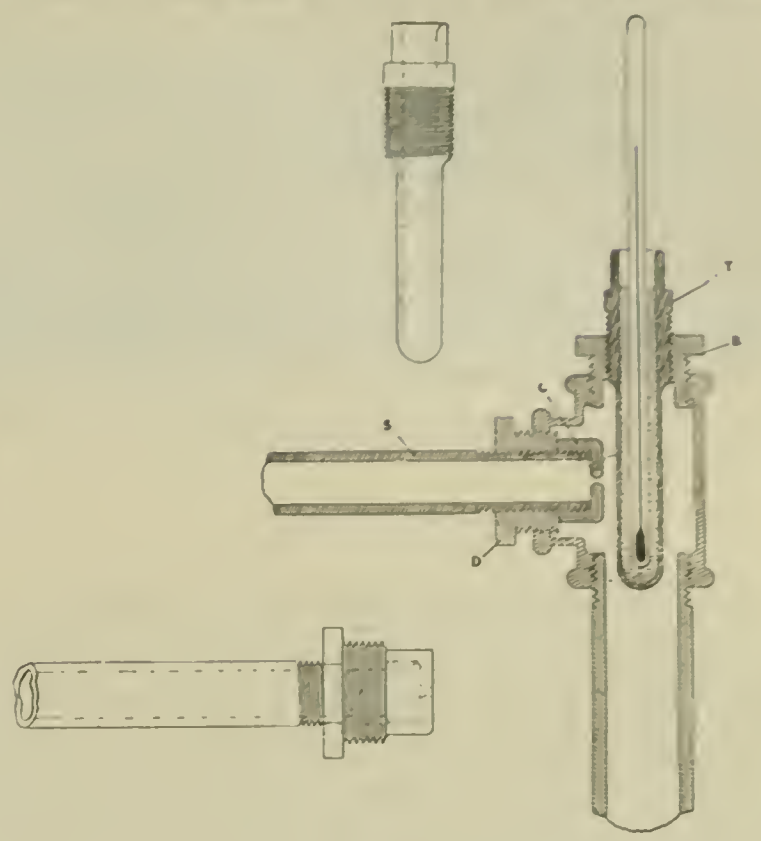


FIG. 2

is 1,151 B. T. U. If, now, steam were allowed to expand without doing work on any body except itself, from 80 lbs. to 20 lbs. pressure, 26 B. T. U. would be liberated for each pound of steam. Since, at 20 lbs. pressure 954 B. T. U. are required to evaporate 1 lb of water, we should have additional heat sufficient to evaporate 26÷954, or .027 lbs.

Now, if the original steam contained less than 2.7 per cent. of moisture, a thermometer placed in the steam would show a temperature higher than that due to a pressure of 20 lbs., which is 228° F. In such a case it would be possible to compute the percentage of moisture in the steam ; but if the steam contained more than the above percentage of moisture, the heat would not be sufficient to evaporate it, and the reading of the thermometer would be equal to that of the boiling point of the given temperature ; thus no computation of the moisture contained in the steam could be possible. That is, a throttling calorimeter cannot be used if the steam contains much over 2.5 per cent. of moisture, but it is very convenient and accurate within its limits of operation.

To operate the instrument, connect up as shown and fill the thermometer tube with some heavy oil, cylinder oil probably being the best. Now, having inserted the thermometer, open the valve and allow steam to flow until the temperature has become constant, which will be but a short while ; when the conditions are such, read the thermometer, the operation then being complete.

The quality of the steam may be then readily found by substituting in the following formula :

$Q = [H - S + .48\ (T - 212)] \div L$, where Q = quality of steam ; H = total heat at atmospheric pressure ; S = temperature of steam in boiler at absolute pressure (gauge pressure + 14.7 lbs.) ; T = temperature observed in calorimeter, that is, reading on thermometer ; L = latent heat of steam in boiler at absolute pressure.

Values of H, S and L, may be found by consulting steam tables found in all mechanical handbooks, and are also furnished gratis by some builders of boilers. The percentage of moisture is, of course, $100 - Q$.

* From the *American Electrician*.

SAFETY VALVE PROBLEM.

In our July issue we printed a solution of a safety valve problem in which the weight required on the lever was incorrectly stated. The conditions were : lever, 36 inches ; diameter of valve, 3 inches ; fulcrum, 3 inches ; pressure 125 lbs. The required weight on the lever is 73.625 lbs. The formula for solving such problems is :—

Area of valve = A = 7.068.
Length from fulcrum to weight = L = 36".
Length from fulcrum to valve = l = 3".
Weight of ball = W.
Load on safety valve = area × pressure.
Steam pressure = 125 lbs. = p.
Weight of valve and lever not taken into account.

$$W = \frac{A \times p \times l}{L}$$

$$W = \frac{7.068 \times 125 \times 3}{36}$$

$$W = 73.625 \text{ lbs.}$$

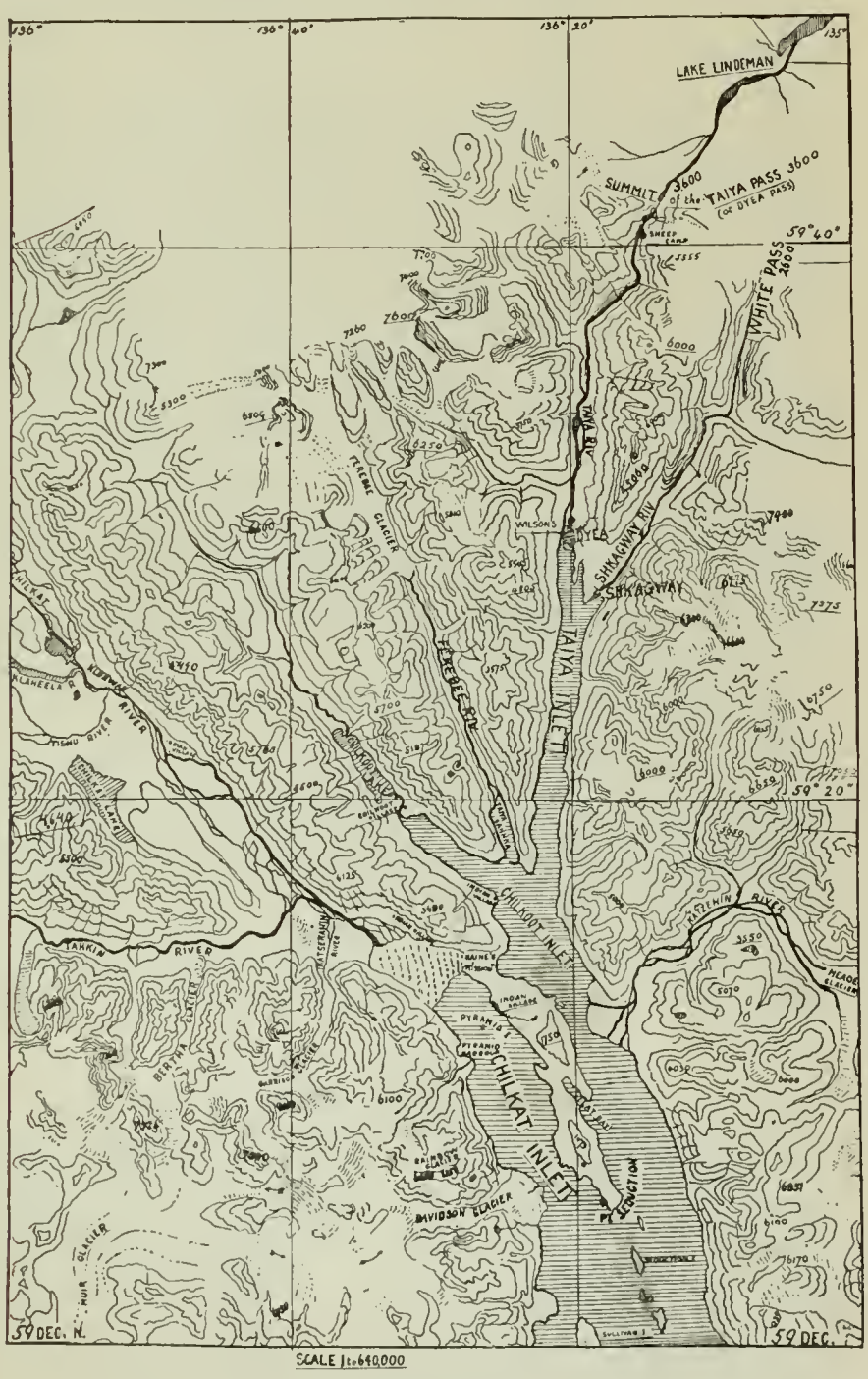
From a mountain 6,250 feet high between Davidson and Rainbow Glaciers, looking northerly.

From a mountain 6,250 feet high near Davidson Glacier, looking N. E. towards the mouth of the Katzchin River.

A PANORAMA OF THE INLET

THE CANADIAN YUKON GOLD FIELDS.

The London *Punch* published the other day a cartoon on the Klondike which will not be very comforting to those whose friends have already started for this world-famous region. It depicts a mountain with a shining golden summit. Death, accompanied by ravenous wolves and a polar bear, sardonically watches the struggling climbers. The one nearest the bear is already exhausted, and those behind him are appealing, without hope, to the gold which has become to them a god. Such a picture will serve a useful purpose in making the grapes seem sour to those whose poverty or delicacy prevents their attempting the enterprise, and also as a powerful hint to those whose capital of coin and iron constitution promise certain success.



SCALE 1:640,000

The Dominion Government has energetically taken up the task of regulating the mining operations of the Klondike and the improvement of the means of transport, etc., is engaging its earnest attention. One of the most important operations is the survey of the White Pass—the easiest route from Dyea or Shkagway. This is being done by C. E. Carthside, a civil engineer of Juneau, and six assistants, at the instance of an English syndicate which intends to run a railway from Shkagway, a few miles from Dyea, to the Hootalinqua River, a distance of 110 miles. The highest altitude to be reached is the summit of the Pass, 2,600 feet, about 20 miles from Shkagway, where wharves and warehouses are to be built. This surveying party has been at work since the 28th July, and is already twelve miles up the river. The work is to be pushed on so that the line will be completed as far as Taku Arm next year. At present this pass, though the easiest, presents terrible obstacles, and it is so difficult to get horses over it that the track is dotted with baggage abandoned until a more favorable opportunity arrives for its carriage. But a line even to Taku Arm will considerably lessen the difficulty and land the miner near a waterway which is navigable for miles at a stretch through the Teslin and Lewes Rivers into the Klondike itself at Fort Selkirk.

Many other schemes are being talked over, such as transport cables, etc., and meanwhile a force of about 1,000 miners who are obliged to wait for a favorable opportunity to transport their baggage, are at work on the trails with pick and dynamite preparatory to the work of the shack builders and trail makers sent out by the Government. In addition to this, new steamship companies are incorporated almost daily. The North-West Trading and Transportation Co. has just let a contract for three more steamers which are to ply the Yukon between St. Michaels and Dawson City. That means that this company alone will have eight steamers on the Yukon. Up to the present, navigation has been very difficult, but a company of New York capitalists is building a gigantic dredge capable of removing about 900 tons of sand or gravel per day. And this is to traverse the Yukon and render navigation as easy as if on the busy waterways nearer home.

LOOKING DOWN THE YUKON FROM OGILVIE'S OBSERVATORY.
From a Photo by Capt. Deville, Surveyor-General.

In the holding of a claim, might is still right, but the might of the individual is now substituted for that of wise government regulations and protection. Inspector Constantine has been for some time acting as commissioner in the Klondike, empowered to fix the limits of all claims and report them officially. Until the arrival of the new administration he is acting in a semi-judicial capacity and settles all disputes under the direction of the Government at Ottawa. This primitive arrangement was not, however, intended as permanent, and Major Walsh, of Brockville, has been appointed as administrator of the district and commander of the Mounted Police. The major's qualifications and the popularity of his appointment have received so much attention from the daily press that it is unnecessary for us to add anything on that head. The new administrator does not at present intend to hold his office for a long period, but he will see the territory in thoroughly good working order before he returns to his home in Brockville. Lieut.-Col. Henry Aylmer, of Winnipeg, was appointed as clerk of the court and registrar. He has since resigned that post, but there is no lack of applicants, and the office will be filled by some other qualified person. The Minister of the Interior has decided

From a mountain 6,350 feet high between Davidson and Rainbow Glaciers, looking east towards Point Seduction.

From a mountain 6,250 feet high between Davidson and Rainbow Glaciers, looking S. S.-E. down Lynn Canal.

From Photos by W. F. KING, Chief Astronomer to the Dominion Government.

G TO THE KLONDIKE PASSES.

to accompany the major and his party as far as Tagish, so as to inspect for himself the facilities for landing passengers and traffic, and conveying them over the summits of the passes. In order to keep the balance of justice in case of differences or crime, Judge McGuire, of Prince Albert, has been transferred to Dawson City, where his court will be held. A gold commissioner has been appointed to take over some of the duties hitherto performed by Inspector Constantine, and has power to make such regulations as his experience proves necessary for enforcing the law on placer mining, and a force of eighty Mounted Police, with a Maxim gun, are already on the way. This force is likely to be increased to 125.

The arrangements for the carrying of mails are nearly complete. This has been done by the friendly co-operation of the Canadian and American Governments. The latter Government will carry the mails free from Victoria to Dyea, when they will be handed over to the Mounted Police, and the Canadian Government undertakes that the mail shall be carried once a month between Dawson City and Dyea, Both these cities will be declared International Postage Exchange offices. There are already post offices at Dawson City, Fort Cudahy, and Forty Mile, and others will necessarily follow. This arrangement is to be supplemented by the work of a Government commission consisting of an astronomer, surveyors, geologists, and telegraph experts, part of whose business will be the establishment of telegraph communication between the various important points and telephone lines between the principal mining camps. That so much has already been done for a hitherto almost inaccessible district in the interest of human life and comfort, affords a strong presumption that ere long the only deterrent will be that of the climate, and even that is in some measure subservient to the advances of industry and civilization.

Both Dawson City and Shkagway are assuming the appearance of municipalities. Late last year the inhabitants of Dawson City numbered 4,000, and Mr. Ladue, who owns the site, estimates that next June it will have run up to 25,000. It may not, of course, remain at that figure; but a residue of the miners, and the certain increase of stores of various kinds, will make Dawson a very considerable town. Already it has a saw mill and Presbyterian, Baptist, Methodist and Roman Catholic churches. It is the headquarters of the Mounted Police, and the Government intends to establish a bank there, where the gold of the miners can be deposited and exchanged for drafts. This will, of course, necessitate the establishment of an assay office. Shkagway has already a Broadway and several avenues, and many of the miners are locating lots and building houses. It is estimated that next year its population will reach 5,000.

The number of edible vegetables and fruits that can be grown in the region is larger than at first supposed. Wild onions, rhubarb, blueberries, cranberries, salmonberry, wild raspberries and red currants grow in abundance on the sides of the mountains, and the Department of the Interior has just received from Mr. Ogilvie a bunch of wheat bearing the following card: "Grown at Fort Cudahy from accidental planting in the autumn of 1895. All from one root and cut 14 inches above ground, Sept. 7th, 1896." August 27th, min. temp, 31 8; August 31st, min. temp., 27.2; Sept. 1st, min. temp., 27.6. The wheat is not of the highest grade, but it is good nourishing grain.

The severe cold for so many months in the year seems to present the greatest ultimate difficulty, but Mr. Ladue says he has chopped wood in his shirt sleeves when the thermometer registered 70 degrees below zero and suffered no inconvenience.

Judge McGuire, who will preside over the courts of the Yukon district, was formerly a partner of the late James O'Reilly, in Kingston, and has for about twelve years been one of the judges of the Supreme Court of the North-West Territories.

A. E. Mills has gone from Victoria to Lake Teslin to erect a sawmill there for F. M. Yorke, who also contemplates building a steamer on that lake.

A report from Lake Lyndeman, dated last month, says there are about 400 men on that lake and Lake Bennett building rough boats in which to descend the river to the Klondike mines.

NEAR THE HEADWATERS OF MILLER CREEK, YUKON DISTRICT.
From a Photo by Capt. Deville, Surveyor-General.

James D. McGregor, of Brandon, has been appointed inspector of mines for the Yukon, and is on his way to the Klondike.

On the authority of Hon. James Orr, the first member for Cariboo in the crown colony parliament of B.C., and John King, a Spokane miner, the B.C. *Mining Journal* gives the following as an easy pack route: Ashcroft to Quesnelle, 220 miles; Quesnelle to Fort Fraser, 140 miles; Fort Fraser to Decker Lake, 30 miles; Decker Lake to Hazleton, 75 miles; Hazleton to Kispiox, 9 miles; Kispiox to Stickeen above canyon, 90 miles; Stickeen above canyon to Teslin Lake, 120 miles; total, 684 miles, with good feed from the first of May until fall all the way. At no point is there a stretch of more than 20 miles without good feed. For hundreds of miles peavine is found in profusion, and blue joint stands along the lakes and water courses higher than a man on horseback in places. There are no high divides to cross, and good roads could easily be made from Quesnelle to Lake Teslin, on which route fresh horse feed can be had in plenty from 1st May to 1st November. The Hudson Bay Company turn out its "cayuses" all winter, and in the spring they are fat. They paw up the snow and get at the grass. In Lake Teslin salmon are captured weighing as much as 40

pounds. Grouse and pheasants are sometimes got, but the great game bird is the ptarmigan, of which countless thousands may be shot. The climate is not bad, and Mr. King knows families of white people who have lived n this route for 30 years and reared children. He says: "The man who goes to the Klondike by this route is exposed to few more hardships than in any new country. He can go nearly every foot of the way on train, steamer, horse and small boat. Once at the head of navigation, the man with an outfit can employ Indians to do the drudgery of camp life and will be sure of safe pilots. The Indians, Taltons and Stickeens get $2 a day and board. They do the cooking, set up the camp and perform all other duties." It may be added that this route, as far as Telegraph Creek, has been used more or less ever since the days of the Cassiar alluvial mining days of 1870, and has been traversed by thousands of miners. Reports by the Government geologists show that all the regions bordering on this route are highly mineralized, and generally speaking have been scarcely touched on by the prospector The Canadian Pacific are now building a telegraph over this route. The line starts from Quesnelle, on the main line, and runs north-westerly to Fort Frances, thence to Hazleton, then to Telegraph Creek, then to Lake Atlin (from which a branch will run down to Dyea), and from there to Fort Selkirk and Dawson City.

It is safe to say that the world will know more about the great North-West of Canada in the next six months than it has known in the past sixty years. By each steamer newspaper correspondents are going north from Victoria, and from San Francisco, and Seattle, representing not only the leading Canadian papers, but American and European publications, including such papers as *Harpers'*, of New York.

A man named Johnson has come down to Vancouver with his partner, bringing $18,000 as the result of a strike this season on the Peace River, where they had been for three months working with pans and 12 foot sluices. Other miners were remaining there all winter, depending for their supplies on the H. B. Co.'s boats, and were taking out large quantities of gold with the crudest appliances. Owing to these finds it is proposed to organize a company, which will put new steamers on the Athabaska and Peace Rivers. The question of the route to the Yukon by these rivers and the Mackenzie is well treated in Edmonton *Bulletin* of Aug. 12th, in which two routes are considered cheap and practical, one being by way of the Pelly and the other by the Porcupine branches of the Liard River, starting from Athabaska Landing. These routes have already been taken by a number of people from the North-West Territories. The distance from Edmonton to the Klondike is 1,400 miles as against 1,600 by the Chilkoot Pass and 4,400 by Behring Sea. A surveyor who has been over the route says one difficulty is the time lost in ascending the Yukon to the Klondike after going down the Porcupine, but such points will soon be determined; but meanwhile it may be said in favor of these routes that the discoveries of gold and other minerals this side of the Yukon—such as noted above—will render them attractive to the prospector. There may be more than one Klondike in the vast area of utterly unexplored country accessible from these routes. We can quite agree with the *Bulletin* that an all Canadian, all-land route, affording access to the north at all seasons, is the most pressing necessity if the wealth of this region is to benefit the trade of Canada.

W. T. Jennings, the well known civil engineer of Toronto, is at the head of an exploring party whose mission is to determine the best route for a railway to the Klondike. Mr. Jennings is now reported on his way to the Stickeen. Meantime, an American party under W. A. Pratt, of Wilmington, Del., is projecting a railway for an American company.

The Alaska *Mining Record* has compiled a list of the amounts brought down by the miners during the present year, the total, including miscellaneous small finds, making over $6,000,000. The steamer "Portland," on her latest trip down to Seattle, brought gold-laden miners whose "piles" amount to a total at first estimated at $3,500,000, but which afterwards proved to be $575,000. Some of these returning miners declare that the half has not yet been told of the riches of the Yukon district. A party has returned to British Columbia, reporting strikes on and around a creek near Klondike amounting to $160,000, but the finders are not disposed to give particulars. The most important information to hand since last issue is that brought down by Mr. Ogilvie, the Government surveyor, now on his way to Ottawa. He is reported to have made the calculation that 180 claims now worked on the Eldorado, Bonanza and Hunter's Creeks will, in three years, at their present rate of production, yield $70,000,000.

The London *Times*, in an article on the Klondike, says it is not easy to overrate the importance of the gold discoveries, which will prove a great incentive to the colonization of the Canadian North-West, because of the supplies of foodstuffs, etc., demanded by mining operations, and the fact that thousands who go out to mine will remain to settle on the lands. It was so in California, in Australia, and in South Africa, and will be so in Canada.

The Victoria *Colonist* mentions the following facts: In 1880 John McKenzie, a Canadian, with a party of Canadians, went down the Lewis River to Lake Lebarge. He was the first white man to run the White Horse rapids. He may be said to have discovered the route into the Yukon valley. The first discoverer of gold and mineral on Stewart River was a man named Fraser, from Nova Scotia. Franklin Gulch and Forty Mile Creek diggings were discovered by three Canadians named McCue, Stewart and Franklin. Davis Creek was discovered by a party consisting of one Canadian and four Americans. Miller and Glacier Creeks were discovered by a party consisting of Canadians and Americans. Birch Creek was discovered by a party consisting of three Canadians and two Americans. Klondike was discovered by a Canadian named Henderson.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The eighth annual convention of the Canadian Association of Stationary Engineers was held on the 19th and 20th August in the City Hall, Brockville, Ont. The first morning (Thursday) rain damped the hearty spirits of the delegates and put Brockville, as the entertaining city, at a great disadvantage. As a result the day's session was more fruitful in hard work than any other day in the history of the Association.

The delegates met about nine o'clock, and although seriously intent on work, about half an hour was spent in amusing reminders of the last convention. One incident was the presentation of an axe to President Devlin by Ald. McCrady. This had, no doubt, some timely significance, and though not on the programme, it evidently could not be described in the ordinary platitude as "a surprise to all concerned." The members were called to order at 9.30, and Ald. McCrady introduced Mayor Downey, of Brockville, who said he was pleased to have the privilege, as Mayor, of welcoming the engineers to Brockville, because he found that the objects of the association were praiseworthy. He continued: "If we look at any of our great factories, with hundreds of skilled operatives, guiding and directing machinery of many different kinds, which is driven by power derived from one central source, or at the waterworks or electric light system of a great city, we shall find the steam engine the source of all the power, controlled and regulated by a faithful and energetic man, on whose skill and integrity the successful operation of the whole elaborate system depends. How important then that the engineer should be a competent and trustworthy man, thoroughly skilled in all his duties, and I congratulate you and the public that your association devotes its energies towards securing the attainment of this most desirable end."

Then calling attention to the advantages of the town he said: "We have extensive manufacturing and other business establishments amongst us and also those various municipal improvements which mark a progressive nineteenth century town. Besides having an excellent system of water works and sewerage, our town is lit by gas and electric lights. We have commenced putting down granolithic sidewalks, and are looking forward to an electric street railway in the near future," and concluded: "Gentlemen, once more I welcome you to our town and invite you to feel at home in our midst, and I do most sincerely trust that your stay amongst us will be both pleasant and profitable, and will mark a step forward in the history of your association."

President Devlin thanked the Mayor on behalf of the delegates, said they would be pleased to welcome the Mayor and aldermen to any of the sessions, and invited the Mayor and Council to join the water party in the afternoon. Brief addresses then followed from the aldermen present.

After a few words from President Devlin, the Mayor and Council retired and W. F. Chapman read his address of welcome on behalf of Brockville, No. 15.

ASSOCIATION'S WELCOME.

Mr. President and Brethren:

On behalf of Brockville Subordinate Association, No. 15, C.A.S.E., it affords me a great deal of pleasure to extend to the Executive Council and delegates of the Canadian Association of Stationary Engineers, at this their eighth annual convention, a hearty welcome to our town. This is the first time that Brockville has been honored with a visit from the representatives of the large army of stationary engineers in the Dominion, and I trust that your brief sojourn with us may be both profitable and enjoyable, and that when you return to

your homes you will bear away with you pleasant recollections of the Island City of the St. Lawrence and of its people. While this association partakes largely of the character of a mutual improvement society, its chief object being the educating of its members to a higher standard of excellence in their work, still it is not without its social side, and the development of the latter along proper lines tends much towards the achievement of success in the former. During the eight years of the association's existence, excellent progress has been made, and the highly satisfactory results testify to the necessity that existed for such an organization which would bring together men engaged in the same occupation for fraternal intercourse and consideration of matters of interest to all. No one man knows it all in any one line of business, and it is only by free discussion and interchange of ideas that the safest conclusions are arrived at, and the best results are achieved. The position of the stationary engineer in Canada has greatly changed during the past few years. Previous to that time every man was working away along a line of his own, and knew little and cared less for what others around him were doing. Now this is all changed. At the meetings of our association difficulties which individual members meet with in their daily work are presented and discussed, and it is a knotty problem indeed for which a satisfactory solution is not found. In this way a large amount of theoretical knowledge is gained, which, added to the practical experience already acquired, makes every one who listens to or takes part in the discussion a better man. It is necessary to keep abreast of the age in which we live, and nothing helps more in that direction than frequent interchange of thought and close attention to what is going on in the world around us. While the members themselves thus reap a great advantage, their employers are also benefited, and much trouble and expense are often averted by the engineer knowing exactly what to do when a difficulty arises. In this way the association has begun a good work, which it is hoped it may long continue to carry on. Again, on behalf of the association I represent, I bid you welcome to Brockville, and extend to you the freedom of the town during your stay with us.

The roll was then called, the following members answering:
Toronto, No. 1—G. C. Mooring, James Huggett, Chas. Mosely, A. M. Wickens.
Montreal, No. 1—J. J. York, J. G. Robertson.
Hamilton, No. 2—Robert Pettigrew, Geo. Mackie.
Stratford—W. G. Blackgrove, John Fox.
Brantford, No. 4—Thos. Pilgrim, A. Ames.
London, No. 5—G. B. Risler, Wm. Gerry.
Ottawa, No. 7—Thos. Wensley, F. J. Johnston.
Dresden, No. 8—T. M. Steeper, Wm. Jameson.
Kingston, No. 1—C. Selby, F. Simmons.
Kincardine, No. 12—Jos. Walker, Percy Ashton.
Wiarton, No. 13—J. F. Cody, Ed. Dunham.
Peterboro, No. 14—Fred. Donaldson, John Morency.
Brockville, No. 15—F. P. Andrews, C. Wilkinson.
Carleton Place, No. 16—Hugh McKay, W. J. Griffith.
Waterloo, No. 17—Chas. Uttley, Fred. A. Pflug, together with the Executive officers. District Deputies Granberg and Cody were absent. The following committees were then appointed :

Credentials—J. Huggett, Toronto; C. Selby, Kingston; Nathan Uttley, Berlin.

Constitution and By-Laws—J. J. York, Montreal ; G. B. Risler, London; A. M. Wickens, Toronto.

Mileage—Jos. Robertson, Montreal; G. C. Mooring, Toronto; F. M. Steeper, Dresden.

Good of the Order—F. Simmons, Kingston; C. Mosely, Toronto; J. McKay, Carleton Place.

A lengthy discussion then took place on J. J. York's suggestion that the associations admit to every meeting bona-fide steam-users. Many employers seemed to think the C.A.S.E. was a labor organization, and to remove this error, he suggested that an invitation card containing the subject of the paper and name of reader be sent to steam-users every month.

President Devlin then read his opening address as follows:

I have the honor to welcome you to this our eighth annual convention. I am aware that in selecting you as delegates our various branches have sent their best men; consequently I am confident that your deliberations will result in the advancement of our organization, and that in dealing with the various subjects brought before you, the one and only aim sought shall be the greater good of the C.A.S.E. I am sure that naught but good-will shall prevail; indeed, such is one of the cardinal principles of our order. I need not ask for your hearty support, as this has always been given to the occupant of this chair. The committee appointed to act jointly with the C.A.S.E. to draft a bill seeking from the Dominion Parliament a law compelling engineers to pass an examination and hold certificates of competency, met in Toronto on March 17th last. The result of the deliberations and a copy of the bill will be laid before you. As you are aware, the bill received two readings in the House of Commons, and I am assured by the delegates who had charge of the legislation at Ottawa that, were it not for the lateness of the session, there would have been every prospect of the bill becoming law. The thanks of this association are due James Sutherland, M.P., for the kind reception of our delegates, and for his earnestness in endeavoring to have the bill become law. In this connection I should say that in this movement not only are the members of our association a unit in favor of such a law, but, I might add, almost all the qualified engineers of this country are with us, as well as most of the manufacturers and steam-users. During the past year some of our branches which had for some years shown want of vitality have been resuscitated. They are now possessed of fair membership, active and diligent in the work of the order, educational and social. London particularly is doing good work. On the whole our membership, however, shows a slight increase this year over last year. Guelph and Stratford, I am sorry to say, are not in a prosperous condition, and some effort must be made to infuse new life into these tardy branches. During the past year I can only report the establishment of one new association, that at Waterloo, Ont. It is to be hoped that during the coming year more advancement will be made in this regard. However, whilst our membership may not have materially increased in numbers, there has been greater care exercised in the selection of members, and the principles of the order have been most rigidly adhered to. I am most pleased to know that in some of the lodges the work is done with great precision, the use of the book of ritual being dispensed with by many of the presiding officers. The educational work, the great feature of the organization, goes on with greatly increased vigor and benefit to the members. During the year I had the pleasure of attending meetings at our two great centres, Montreal and Toronto. In both I was struck with the material progress visible and the facilities available to members by way of books, models, etc., whereby the educational benefits, so invaluable and important, are advanced. This feature of our association's work cannot be too highly appreciated. It may be necessary at the present convention to again take up the matter of bi-annual conventions, with a view to the curtailment of the expense necessary for an annual meeting. Steps should also be taken to arouse the engineers of the Dominion to the loss they sustain in not being of our membership. The provision made at last year's convention for the issuing of certificates of membership has been carried out. The matter of getting up a hand-book souvenir from which we expected to realize sufficient funds to meet the expenses of the convention has not taken practical shape, consequently, for this year at least, our old sources of revenue will have to be relied upon. Our worthy secretary and myself have been in correspondence for some time past, and he will lay before you very important information on the subject, which will be of great value when the postponed work is again taken up. Difficulties and persecution which I have encountered in common with others in the same employ have rendered it impossible for me during the past seven or eight months to give the active work to the accomplishment of the souvenir scheme which I had wished. Brethren, in conclusion, I desire to express to you my deep sense of gratitude for the great honor you conferred on me a year ago when you elected me to the high and honorable position of president of this association, and for the loyal manner in which you have stood by me. In closing, I will only add it is my heartfelt wish that your deliberations at this meeting may be so conducted towards each other that everything we shall do will redound to the benefit and honor of our good association.

Secretary Chapman then introduced W. H. Comstock, who offered the delegates the use of his steam yacht for a trip among the Thousand Islands. President Devlin tendered the hearty thanks of the convention to Mr. Comstock, and hoped he would allow them the privilege of electing him an honorary member, which was done.

The weather was so bad that the trip was postponed until

the next afternoon, on the understanding that the rest of the day be devoted to business.

President Devlin then announced an invitation from R. A. Bush, chairman of the Entertainment Committee, to visit the Brockville Asylum, of which he is chief engineer. This was declined owing to pressure of business.

An adjournment was then proposed by J. G. Robertson, seconded by W. G. Blackgrove, and carried.

The convention met for the afternoon session at 1.30. The appointment of auditors was the first business. They were J. Robertson, Montreal; F. Donaldson, Ottawa; Geo. McKay, Hamilton; F. P. Anderson, Brockville.

The report of the Committee on Credentials was presented and adopted.

Report of the Committee on By-Laws: J. J. York did not think it necessary to present a written report, as the articles permitted all that had been proposed with regard to hon. members.

J. Robertson asked: Is the C.A.S.E. incorporated? No? Well, the sooner the matter is taken up the better.

Vice-President Philip: Toronto, No. 1, was incorporated with power to appoint other associations. Toronto, No. 1, transferred all its powers to the Executive of the C.A.S.E.

J. Robertson: That is not the idea.

A. M. Wickens: The corporation was first called the C.A.S.E., and the present lodge is said to be located in Toronto. After running a year or two Toronto turned over her power to the C.A.S.E., and payment was made for all disbursements made by Toronto. He agreed that the C.A.S.E., as we now know it, should be incorporated, so as to act equally and legally in every province. Under a Dominion Act this would cost some $200, while the local Act cost $23.

J. Robertson: Montreal is incorporated under the laws of the Province of Quebec, but still it is local. Now the simple act of Montreal turning over its power to another association does not mean that the other association is incorporated.

Vice-President Philip: In asking for incorporation you have to state the names of those composing the proposed corporation, and the place where the office is. But fifteen minutes after incorporation you can change the personnel. This is all that was done by Toronto, No. 1. However, a Dominion Act would be better.

Jno. Murphy: When the C.A.S.E. was formed it took over the charter and seals of Toronto, No. 1. That charter is in the possession of the C.A.S.E.

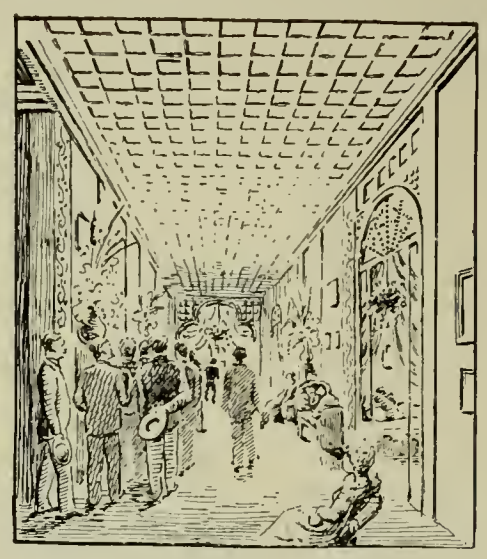
J. J. York: When I was Executive secretary, I made an attempt to draw a line between Toronto, No. 1, and subordinate associations. I never saw a charter of any description—nothing but the blank lithographed form which is filled in for subordinate associations. There was no seal until I got one made. I never heard of a sealed charter.

At this point Ald. McCrady entered and said that as the weather seemed to be settling for fine, he would procure rigs to take the party to the asylum, if it were agreeable to them.

C. Mosely proposed, and J. Robertson seconded, that all reports be deferred till the next day.

President Devlin then made a few remarks respecting legislation. He had not yet heard from the delegates, but it was said that opposition was coming from Quebec. The delegates from Quebec are here, he said, and the delegate to the Ontario Government (A. M. Wickens) is also present. A. M. Wickens said that at the second reading of the bill there was a strong opposition by the French members. He strongly advocated a Dominion law. Chas. Mosely suggested that this matter be left to the Committee on the Good of the Order. F. Simmons moved that J. J. York and J. Robertson, of Montreal, and A. M. Wickens, the deputy to the Ontario Government, be added to the Committee on the Good of the Order. This was seconded by C. Mosely and carried.

The convention then adjourned for the trip to the asylum. The party drove past Brockville's most beautiful homes, some of them belonging to men whose names are known to the English-speaking world. One of the most charming was that of Major Walsh, who within a few days will start for the rigorous Klondike region, there to exercise the function of Governor over a board of sturdy men such as only a mining boom can gather together. The party was received at the Asylum for the Insane by Dr. Murphy and staff, and conducted round the wards by Ald. O'Brien. These wards are winning in appearance. They are constructed on a light, airy plan, and decorated with an elegance calculated to subdue all grossness and inspire a habit of placid contentment, as useful to the sane engineers as it was necessary to the deranged inmates. Notwithstanding the deep sympathy that was generally felt for those whose liberty was restrained for apparently so light a reason, the visit acted as a pleasant and wholesome pause to the hilarity which



CORRIDOR IN THE ASYLUM FOR THE INSANE BROCKVILLE.

belongs to the convention. After visiting the kitchen, laundry, engine-room and pumping station, and congratulating R. A. Bush on the condition of his boilers and machinery, the party drove on to the fire and electric light station. On the return to the St. Lawrence Hall, Ald. McCrady gave an alarm of fire. The fire station was a quarter of a mile away, but in the space of one minute 50 seconds the hose was throwing its full stream of water in front of the hotel and far higher than its roof. Snap-shots were taken by Vice-President Philip of the firemen, engine and horses, and they departed amidst the hearty cheers of the delegates.

The delegates gathered for the evening session at 7.30. Ald. McCrady introduced Ald. Cash, Thompson, and the chairman of the Board of Works, E. A. Buchman. F. Simmons presented the report on the good of the order, which proposed that the holding of the convention bi-annually be considered at this meeting. It recommended that a committee be composed of one man each from Toronto, London, Ottawa, Montreal, and Kingston, to take up the work of legislation, and carry it through without delay, and that these men be appointed by their respective lodges. It also recommended that the subordinate lodges be requested to create as many hon. members as possible from among steam-users. The discussion of this was taken up later on.

A. M. Wickens was then called upon for his paper on the C.A.S.E. He had not written a paper, but proceeded with an interesting address. He said in effect: One of the most vital things to the organization is to keep up the interest during the convention. The lodges should be well represented, and

"GRANDPA" ON THE C.A.S.E.

the programme of business adhered to rigidly. We ought to be making more rapid strides than we are doing. This association is unique in its general laws and working. The foundation is education and our mottoes are Safety, Economy, Re-

liability. It is purely an educational society, and the members spend their own money in educating themselves. An engineer can save his employer much money, and he is entitled to a share of that, and indeed, sometimes gets it. Since the object of the association is to educate engineers up to this point, we should leave no stone unturned to secure the membership of capable men, who are interested in the object. Too many men get interested for a time, and then fall out. He thought that the best way to secure interest in the general meetings would be to get live secretaries. Those who have acted have done their best, but it has been for love. Why not pay the secretary a little for his trouble? This would considerably strengthen his hands. There are 4,000 engineers in the Province of Ontario, but they are so scattered that it is difficult to get them together. Many of the towns have so few plants that there are not enough members to make a branch and rent a room. From the successes that we have made in educating young men we should naturally think that we have more good men in the organization than appear. It takes money to run a branch, and the secretaries are sometimes to blame for not looking after the subscriptions. Then the Executive secretary should keep in close touch with all the branches by writing to them every month and telling them of the progress made by other branches. We could start a set of questions to be sent to all the branches. An extra movement should be made this year to interest steam-users in the coming legislation. This could be done by inviting them to the local meetings.

As the papers to follow were likely to initiate discussions he would now give way to them.

G. B. Risler, of London, then read his paper on "The Use of the Indicator," followed by Vice-President Philip's paper on "The Use of the Tower for Condensing Purposes." Having finished reading the paper, Vice-President Philip added that he recently had the pleasure and profit of installing a cooling tower. When you have to buy water for feeding the boiler the cost renders it out of the question. Then the cooling tower is an advantage. One is used at O'Keefe's brewery. Water is pumped to the top of a tower, which has some filling, wood, tile, or wire, which spreads out the water in falling. The temperature is thus reduced, and the water can be used again. The process evaporates a certain amount of water, and this produces a reduction in the temperature of the surrounding air, which will condense another pound of water. The plant that he was most familiar with was of 500 h.p. capacity. It is a surface condenser. It has 6,400 ft. of tubing, and 1,600 stuffing boxes. The tower is 19 ft. high, and the filling is 11 ft. long. The water goes up at a temperature of 120 deg., and when it reaches the bottom of the tower it is at 68 deg. This is a subject of vital importance to engineers, for as the coal bill keeps creeping up, condensing is one of the best ways of reducing the quantity of coal.

W. F. Chapman: Is the plant expensive?

Vice-President Philip: The tower, piping and condensing cost $7,000. Where there is a yard a jet condenser can be used, and thus lessen the cost.

H. McKay: How long does it take to show the saving?

E. J. Philip: The saving is a net 15 per cent. on the coal bill.

H. McKay: What is the loss of water during evaporation?

E. J. Philip: There is an overflow of water from the top of the tower all the time. But with the cooling tower you can use less water than when not condensing.

J. Murphy: Is not a simple-acting pump much more economical than a duplex?

E. J. Philip: A simple-acting vertical bucket pump is, because the valves close so rapidly. The ordinary horizontal pump is the least economical.

J. Murphy had had some experience with both vertical and horizontal pumps. The vertical in these cases were under some disadvantage certainly, but he had more trouble with the vertical than with six or seven horizontal. His was a Blake condenser.

E. J. Philip: That must be an exceptional experience.

J. J. York hoped that in the near future Bro. Philip would let them have some accurate data on the saving. He did not at present see much saving. Manufacturers must see a larger saving than 15 per cent. before they would lay thousands of dollars in a plant. What is the chief injury to boilers using copper tube condensers?

E. J. Philip: The best evidence is that given by the British Admiralty reports on the British war vessels. The chief trouble was corrosion. In some boilers it eat out along the seams, and sometimes all along the boiler.

J. J. York said he used a great many copper feed pipes and never noticed any matter in the boiler.

E. J. Philip: Well, you don't get much copper piping now. It is not pure copper, and has much brass in it.

J. Robertson, on being asked for his experience with copper piping, said it was with a cooking apparatus run by a small locomotive boiler. He noticed that after two or three months the boiler began to pit. He concluded that the copper had something to do with it, so he run the water into the sewer and found no more pit. He asked would Bro. Philip use the condensing tower in the winter.

E. J. Philip: Yes. Though it is slightly more costly.

J. J. York moved, and J. Murphy seconded, a vote of thanks to the readers. This was adopted and conveyed.

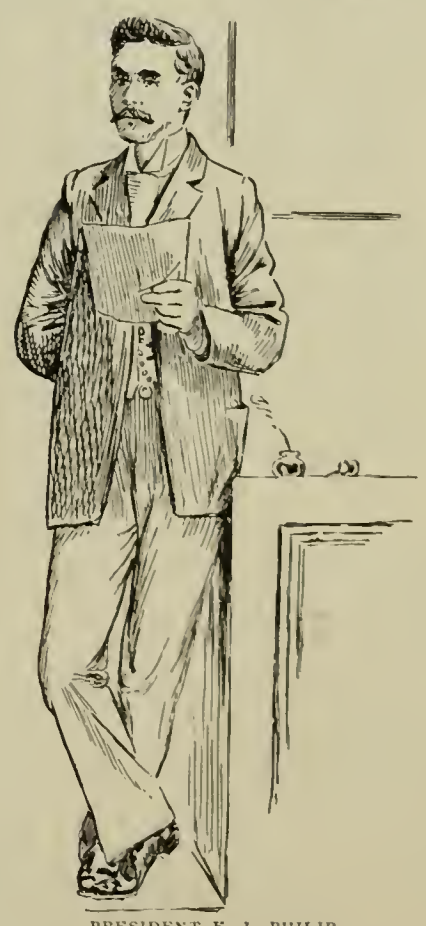
The discussion on the recommendations of the Committee on the Good of the Order was then resumed.

Chas. Mosely proposed, and J. C. Mooring seconded, that the conventions be held bi-annually. J. Robertson sympathized in many ways with the proposal, but two years was too long. A quorum would not be obtained after so long an interval. J. J. York agreed. Each year the attendance is less satisfactory. As it is, there is not enough business done. It would be better to continue as they were. He was much in favor of a paid secretary with defined duties, for this very reason. C. Mosely moved and J. C. Mooring seconded, that the conventions be held bi-annually, unless the laws now before the Ontario Legislature be passed this session. Motion lost.

During an interval the Committee on Mileage presented their report. The actual sum expended was $191.55. The adoption of this report was moved by A. M. Wickens and seconded by C. Selby. The secretary's and treasurer's report showed the finances to be in a very healthy condition, having a larger balance than in any previous year. The adoption of this was proposed by J. C. Mooring, and seconded by J. Murphy.

President Devlin, who had returned to the chamber, proposed a vote of thanks to the Royal Oil Company, who had presented the C.A.S.E. with the sum of $10, per D. Reeves. J. Robertson then presented the auditors' report. Everything had been found satisfactory, and the book-keeping a credit to the organization. Its adoption was proposed by J. J. York and seconded by J. Huggett.

President Devlin then brought up the question of the souvenirs. This, it will be remembered, was to take the form



PRESIDENT E. J. PHILIP.

of an engineer's pocketbook. Letters were read by the secretary from two or three publishing firms who had been invited to tender for the same. E. J. Philip moved, and J. Murphy seconded, that this matter be left in the hands of the Executive, and that it is expected to have taken practical form by the next meeting.

J. J. York moved that the present secretary, F. W. Chap-

man, be tendered $25 for his services during the past year. This was seconded by J. Robertson, and carried.

The meeting was then adjourned till the following morning.

Friday.—The delegates gathered soon after nine o'clock. They had done good work the previous day, and this morning it was difficult to settle down. The first business was the appointment by President Devlin of the scrutineers, who were J. Fox, F. Robert, A. McCallum.

J. J. York then proposed that one ballot be cast for the office of president. This was seconded by J. Murphy, and E. J. Philip, of Toronto, was elected. By the same process F. W. Chapman, of Brockville, was elected vice-president, F. W. Robertson, of Montreal, secretary, and R. C. Pettigrew, treasurer. President Devlin nominated J. C. Mooring as conductor. J. Robertson nominated G. B. Risler. The ballot cast resulted in the election of G. B. Risler. J. J York nominated and J. Robertson seconded J. C. Mooring as door-keeper. He was elected without ballot.

The next place of meeting was then to be chosen. R. C. Pettigrew announced an invitation from Hamilton. J. Murphy proposed, and G. B. Risler seconded, that the invitation be accepted. W. G. Blackgrove announced the invitation of Berlin, and J. Robertson proposed London. The ballot resulted in the choice of Hamilton.

Conductor Murphy was then instructed to fetch in the caretaker, Michael Sullivan. On his appearance the president presented him with a $5 bill as a consolation for the trouble the convention had given him. The next business was the installation of the newly-appointed officers. A. M. Wickens was asked to act as grand conductor, and the most recent past-president, W. G. Blackgrove, initiated the officers, and presented each with the insignia of his office. On taking his seat President E. J. Philip, of Toronto, appointed J. Robertson, of Montreal, and W. G. Blackgrove, of Toronto, to act as district deputies.

Mayor Downey was then introduced, and after one of the little speeches, which ensured his popularity with the engineers, presented Past-President Devlin with a jewel of the customary design and value. Past-President Devlin returned thanks, and promised to devote himself to the interests of the association in the future, as he had done in the past.

J. Robertson then moved, and W. G. Blackgrove seconded, a hearty vote of thanks to the Mayor, Council and citizens of Brockville. The Mayor, in reply, said that he would be indeed a cold-hearted man who did not appreciate such treatment as he and the citizens had received. C. Selby proposed, and J. Murphy seconded, a vote of thanks to Ald. McCrady and O'Brien and other city officials.

P. P. Devlin proposed a vote of thanks to the local press of Brockville. A. M. Wickens, in seconding, said that at no convention had they received better reports.

Mr. Laidlaw, of the *Recorder*, thanked them, and said that it they ever returned to Brockville he for his part would be ready to repeat the operation.

J. Robertson proposed, and J. Murphy seconded a vote of thanks to THE CANADIAN ENGINEER.

J. Robertson moved, and J. J. York seconded a vote of thanks to the retiring officers.

The convention then adjourned to display itself before the photographer.

Afternoon.—At two o'clock the "Albani," Mr. Comstock's yacht, steamed out of Tunnel Bay with the engineers and their friends, accompanied by Mayor Downey and Councillors W. J. Wright and McCrady. The "Albani" ran up to Alexander Bay, where a stay of about half an hour was made. A plentiful lunch was provided on the return trip, after which a very hearty vote of thanks was tendered to W. H. Comstock, on the motion of A. M. Wickens and P. P. Devlin.

The party reached home about 7.15 p.m., and left the dock cheering the captain and engineer of the "Albani." The engineers then repaired to the Council chamber, where J. J. York proposed, and A. M. Wickens seconded, an expression of sympathy for A. E. Edkins, of Toronto, who was prevented by illness from being present.

A. M. Wickens proposed, and J. J. York seconded, a vote of thanks to the Brockville Association, coupling with it the name of R. A. Bush. Ald. McCrady briefly replied, and the convention proper came to an end. The delegates were then escorted by the Island City band and flambeaux back to the St. Lawrence Hall, where at 9 o'clock a dinner was tendered to the delegates by the Brockville branch.

Shortly after nine the delegates and their friends filed into the banquetting hall, and in all about 70 sat down. The Rev. J. C. Sycamore said grace. After the eating interval the toast list was entered upon.

The first toast was, of course, "The Queen," which was accorded the usual honors. The others were as follows: "Canada, Our Home," responded to by the Rev. J. C. Sycamore, ex-Mayor Derbyshire, and Town Clerk McMullen.

"Brockville, the Island City," responded to by Mayor Downey, Ald. McCrady and O'Brien.

"The Manufacturers," coupled with the names of Mr. Geo. Nicholson, of the James Smart Mfg. Co, and Bro. F. G. Johnson, of F. G. Johnson & Co., Ottawa.

"Kindred Societies," responded to by F. Lawrence, D. Reeves, W. J. Jento, and A. M. Wickens.

"The Executive" was replied to by P. P. Devlin, President Philip, Treasurer Pettigrew, Conductor Risler, and Door-keeper Mooring.

"The C.A.S.E." was responded to by J. J. York, W. G. Blackgrove, F. Simmons, F. P. Andrews, and Jno. Fox.

"The Press" was responded to by Mr. Spurrier, of THE CANADIAN ENGINEER; Mr. Healy, of the *Times;* and Mr. Laidlaw, of the *Recorder*.

"The Local Association" was responded to by W. F. Chapman.

"The Ladies" was responded to by J. Robertson, and "Our Host" by Horace Robinson.

Songs were contributed by W. G. Blackgrove, whose admirable voice would be sorely missed, and Frank Roberts, and Tom Daly's recitations won very hearty applause. The National Anthem was sung, followed by the joining of hands and the singing of Auld Lang Syne.

This convention, although short, consisting of only four sessions, will probably be remembered as a business one. This was largely owing to the exertions of J. J. York and two or three of the older members. Legislation when effected will greatly strengthen the hands of the association, and benefit the users of steam. The motion for a paid secretary, and the earnest desire that the Executive should be in continual correspondence with the subordinate associations, will no doubt have the effect of increasing the enthusiasm of individual members and holding their interests; and the desire to get the manufacturers to prove the objects of the association by personal attendance at their meetings, is a sufficient answer to the false impression that the C.A.S.E. is a labor organization.

G. B. RISLER.

G. B. Risler was born in Switzerland in 1858, and in his early days had a great liking for machinery, but going out in the world when but 14 years old to find his own living, he had not the desired opportunity to learn his trade as a mechanic. He soon began the firing of steam boilers, and became now and then assistant in the engine room. In 1884 he emigrated to Canada, and was employed for a number of years as sawmill engineer, and in a woolen mill in the same capacity. In 1891 Mr. Risler was engaged by the London, Ont., *Advertiser*, and is yet their engineer. He has been president of the London branch of the C.A.S.E., and has been very active in promoting the interests of the society. Among other evidences of the sincerity of his words is the

fact that Mr. Risler has prepared and had printed at his own expense a series of examination questions, for correct answers to which he has also offered prizes. The date up to which answers to these questions can be sent to compete for the prizes is September 19th. Mr. Risler is one of the most progressive members of a progressive organization

NEW SYSTEM OF FILTERING IN USE IN A NUMBER OF GERMAN CITIES.

The State Department at Washington has received an account of a new system of filtering water intended for city use, which should be of interest to the authorities of many municipalities struggling with the problem of purifying river water on a large scale for household and manufacturing purposes.

There is now in operation at the city of Worms, as well as at Kiel, Winterthur, and at several other places in Germany, an improved system of filtering water, known as the Fischer system. Hitherto the method most generally employed has been that of filtering through sand or gravel, and for this purpose a layer thirty to forty inches thick of clean sand, mixed in some cases with charcoal, has been used. The sand being loose and non-adhesive, entails two important economical disadvantages ; First, the area of space required is large in proportion to the amount of water to be treated, and, secondly, all sediment in the water settles upon the sand, which forms the bottom of the filter, and which soon becomes gorged and clogged, so that the filter must be thrown out of use while it can be cleaned by mechanical means.

The new system now in use in the city of Worms is the invention of Director Fischer, for many years past water works engineer at that city, where the use of Rhine water for general purposes presents the same problem that confronts cities like Cincinnati, St. Louis and Brooklyn. The fundamental idea upon which the new system is based is the fact that clean, sharp sand, when mixed in due proportion with finely pulverized glass, forms a porous mass which, by baking under a high pressure, may be hardened in any desired form. The inventor in this case hit upon the plan of molding this porous mass into hollow plates or plaques, about forty inches square and eight inches thick ; that is, with walls three inches in thickness and with about two inches of hollow space in the centre of the plaques. In constructing the filtering plant these plates are set upright in groups of batteries of any number, according to the desired size and capacity of the establishment, and are arranged along the lower portion of one or more tanks of hydraulic masonry, where they can be covered to a depth of three or four feet with the water to be filtered. Being then submerged the water is forced by its own pressure through the porous walls of the plate into the interior hollow space, where it trickles down, and is drawn off through pipes laid at the bottom of the tank to the reservoir, which receives the filtered water. These discharge pipes are rigged with cocks so that each plate and group of plates may be isolated for cleaning purposes, while the adjacent batteries are in operation. For greater economy of space and tubing two tiers of plates are set up, one above the other, whereby both tiers are served by one set of discharge pipes. The water in passing through the three-inch walls of vitrified sand is filtered as perfectly as by traversing three feet of loose sand or gravel in the ordinary sand filtering process. The plates, being set upright and close to each other, increase from eight to ten-fold the filtering surfaces that may be condensed within any given superficial area, thus securing an improved economy of space within frost proof structures.

According to an official report of M. Jansen, of the University of Berlin, who made an exhaustive study of the whole subject at Worms, that city began in 1889 to filter the Rhine water for general purposes by the ordinary sand filtering process. With a filtering surface of 13,000 square feet, 792,000 gallons of water were filtered in twenty-four hours. This supply proved insufficient for the city, and it became necessary to construct an addition to the filtering plant, the cost of which on the sand filtering plan, was estimated at $30,000. Instead of occupying new lands and building additional structures, one of the ten vaults containing the sand filters already in use, was isolated, cleaned out and the space filled with a battery of 500 plates of the Fischer pattern. The whole cost of the change thus made was about $9,600, and the new filters occupying one-ninth as much space as the sand filter, doubled the filtering capacity of the entire installation.

THE DEEP WATERWAY FROM THE GREAT LAKES TO THE HUDSON RIVER.

The Secretary of War has transmitted to the United States Congress the report of the chief of engineers on the preliminary examination made by Major T. W. Symons, of the Corps of Engineers, U. S. Army, of a ship canal from the great lakes to the Hudson River. The work was done in accordance with a provision in the last River and Harbor bill, directing the examination and calling for estimates of the cost of construction of the most practicable route of such a canal, wholly within the United States, of sufficient capacity to transport the tonnage of the lakes to the sea.

General Wilson, Chief of Engineers, says in the report that it is the opinion of the local officer that the best route for a ship canal is that by way of Niagara River, Lake Ontario, Oswego, Oneida lake and the Mohawk and Hudson rivers, and that this would cost, at rough estimate, $200,000,000. But Major Symons is also of opinion that the Erie canal, when enlarged under the existing plans of the State of New York, would, if the restrictions imposed by the State upon its use be removed, give commercial advantage practically equal to the commercial advantages of a ship canal. Major Symons says the ship canal is not a project worthy of being undertaken by the general government for the reason that its benefits would not be commensurate with its cost. If this can be further improved by enlargement to a size sufficient for 1,500-ton barges, making the necessary alterations in its alignment so as to continuously give a descending canal all the way from Lake Erie to the Hudson River and canalizing the Mohawk River, Major Symons says, such an improved canal, navigated by barges, would enable freight to be transported between the East and the West at a lower rate than by ship canal navigated by large lake or ocean vessels, and he states that the enlargement of the Erie canal as suggested, with everything adapted to transport the tonnage of the lakes, is a project worthy of being undertaken by the Government, as the benefits derived would be commensurate with the cost, which is estimated approximately at one-fourth that of a ship canal.

Gen. Wilson says that owing to insufficiency of the appropriation only ordinary preliminary examination was made. He says Major Symons, who made the examination, found three possible routes for a ship canal, wholly within the United States. The first extends from Lake Erie via the Upper Niagara, to the vicinity of Tonawanda or La Salle ; thence by canal with locks to the Lower Niagara, at or near Lewiston or some point on Lake Ontario ; thence through Lake Ontario to Oswego ; thence up to Oswego and Oneida River to Oneida Lake, through Oneida Lake; thence across the divide to the Mohawk, and down the Mohawk to the Hudson at Troy. This is designated as the Oswego route, and is the one Major Symons thinks the most practicable.

The second route follows the line of the Erie canal from Lake Erie and the Niagara River to the Hudson.

The third coincides with the first from Lake Erie to Lake Ontario, running thence through Ontario to the St. Lawrence River, and down the St. Lawrence to some point near Ogdensburg ; thence crossing the State of New York to Lake Champlain and up to its head ; thence following in general the route of the Champlain canal to the Hudson at Troy. While Major Symons mentions this as a possible route, he is of the opinion that it is not a practicable one

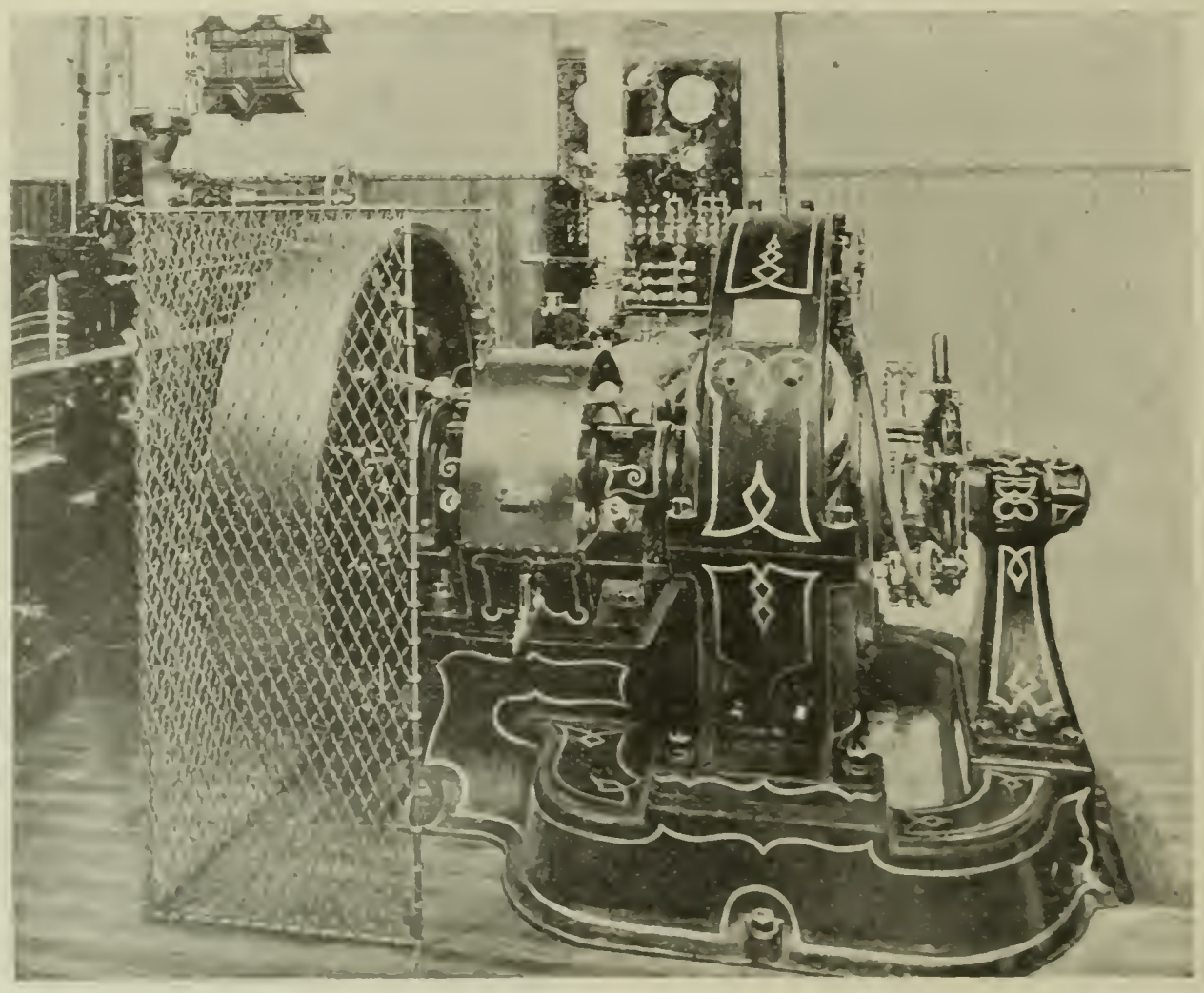
Allusion is also made in the report to still another route, the St. Lawrence-Champlain route, all of which, except a small portion, is in the United States.

The rough estimate, $200,000,000, covers any of the possible routes mentioned. But this estimate, says the report, depends to a very great extent upon the action of the State of New York in regard to its canals, feeders, reservoirs, etc. To maintain such a canal, operate the locks, keep it in repair, etc., would cost at a rough estimate $2,000,000 a year. Such a canal, if constructed, would, the report says, have no military value. Major Symons is of the opinion, says the report, "that the construction of such a canal is not a project worthy of being undertaken by the Government, as the benefits to be derived therefrom would not be properly commensurate with the cost." The cost of the necessary surveys for a ship canal along the Niagara-Oswego route is estimated at $190,000, an entirely independent survey for the enlargement of the Erie canal, $125,000, a combined survey of both, $250,000. In trans

mitting Major Symons' report the divisions engineer, G. L. Gillespie, says: "The subject of transporting the tonnage of the lakes to the sea is exhaustively treated in this report, and the facts stated and the arguments thereon relative to the methods to be followed are worthy of the closest study by Congress." No definite conclusions and recommendations can be given relative to location and methods of construction, he says, until after the suggested surveys have been made.

THE O'KEEFE BREWERY COMPANY'S ELECTRICAL PLANT.

The Canadian General Electric Company has recently installed for the O'Keefe Brewery Company (Limited), Toronto, what is probably the most complete isolated electrical plant installed up to the present in any manufacturing establishment in the Dominion. The generator consists of a 25-kilowatt steel frame machine, direct connected to an Ideal engine, running at 305 revolutions per minute. The design and construction of the apparatus are such, it is claimed, as to secure the highest possible efficiency, combined with the greatest durability in service. The frame and pole pieces are cast from a specially selected



soft steel of the highes magnetic permeability. The construction of the armature is such that currents of air circulate constantly through the core, windings and commutator, ventilating them perfectly. The armature windings are straight copper bars, requiring but two joints for each convolution rendering short circuits and similar troubles practically impossible, and facilitating any repairs which might become necessary on account of mechanical injury. The insulation of all the machines of this type is of the best combining great mechanical strength and durability with high spark resisting qualities. The increase in temperature up to full load is kept exceedingly low, and the use of carbon brushes insures absolute freedom from sparking under all conditions of load. Since starting up, this unit has shown itself to be entirely satisfactory, requiring practically no attention whatever and being perfectly smooth and noiseless in operation. The switchboard consists of a dark marble panel, upon which are mounted the necessary switches and Weston instruments. A triple pole, double throw switch is used to connect the installation with the three wire mains of the Toronto Incandescent Light Company, at such times as it is not desired to keep the plant in operation. The engine and dynamo has been artistically painted to conform with the finish of the other machinery in the engine room of the O'Keefe Company, and altogether the installation is one which reflects the highest credit upon the manufacturers, as well as being a source of satisfaction to the O'Keefe Company. It might be added, that besides the lighting of the brewery, current is furnished to operate several small motors from which fans, ventilators, etc., are run throughout the buildings. The substitution of electric motors for the small steam engines formerly used for this purpose has been at once a great gain in convenience and an important saving in fuel.

THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

The annual meeting of the Society for the Promotion of Engineering Education met at the School of Practical Science, August 16th. Henry T. Eddy, of the University of Minnesota, president, occupied the chair.

Among the prominent members present were: John Galbraith, School of Practical Science, Toronto; John M. Ordway, Tulane University; John J. Flater, Purdue University, Lafayette, Ind.: C. Frank Allen, Massachusetts Institute of Technology, Boston; Frank O Marvin, Joseph P. Jackson, Mansfield Merriman, Harry W. Tyler Ira O. Baker, D. C. Jackson, John B. Johnson, William Kent, Albert Kingsbury, A. Kingsbury, L. S Randolph, Stillman W. Robinson, Robert H. Thurston, Carl L. Mies, W. G. Raymond, Cady Staley, Robert S. Woodward, Arthur Beardsley, Robert Fletcher, Thomas C Mendenhall, William H. Schnermann, M. E. Wadsworth.

In his opening address, Dr. Eddy, as president, dealt with engineering education as it is and as it ought to be. He referred to the development of the profession of engineering during the present generation into a place in public estimation as a learned and responsible profession, like law or medicine. Dr Eddy contended that engineering courses should be completely professional. Two kinds of study interfere with each other, and "culture" studies must disappear from engineering classes. An engineer should obtain his knowledge in those studies preferably before entering upon the study of engineering. Tangible and practical studies were strongly advocated. Organization of the profession and education in the law of contracts were also dwelt upon as very necessary.

After the conclusion of the president's address a paper on "Methods of Teaching," by W H P Creighton, was read. "The Calculus for Engineering Students," by F W McNair, completed the morning session. At the evening session "The Teaching of Machine Design," by J. J Flater, opened the session. This was followed by "The Influence of Scientific Research upon the Development of Chemical Technology," by H Bunte. "Chemical Engineering," by J. M Ordway; "The Efficiency of Technical as Compared with Literary Training," by T. C Mendenhall, which called for considerable discussion; "A Course in French and German for Engineers, by A N Van Dell, and "At What Point should Students Engage in Scientific Research and How Much Aid should they Receive from the Professor," by C D. Mark, completed the day's programme.

At the second day's session the morning was devoted largely to the disposal of routine business. The paper on "Mining Vacation Fieldwork," which was promised by Dr. F W Denton, professor of mining engineering in the University of Minnesota, and that on the subject, "To what extent should metallurgy be taught in mechanical engineering courses?" promised by Dr. M E. Cooley, professor of mining engineering in the University of Michigan, were not presented. "At what point should students engage in specific research, and how

much aid should they receive from the professor." was the subject of a paper by Prof. C. D. Marx, who said that the inferiority of the instruction in American engineering colleges, except in the laboratories, was due to inferior preparatory training and the lack of teachers who combine theoretical training with wide practical experience. "The average American teacher is overburdened with work sufficiently to prevent giving efficient assistance to the few who take the fifth year and research work. The work of research is itself desirable if undertaken as post-graduate work and under proper conditions. For success in this work, the professor must have the proper training in addition to practical experience, and must be allowed sufficient time for this special work. Present salaries are not calculated to secure many such men, nor are they allowed time for such work. Student's work in research should follow, not precede research work on the part of the professor." In the afternoon, the members of the society inspected the laboratory in the School of Practical Science and pronounced themselves highly pleased with the completeness of the equipment which the department possesses. Later in the afternoon the members assembled at Prof. Loudon's residence and were guests at the garden party to which they and the members of the Mathematical Society had been invited.

Professor C. M. Woodward read a paper on "Manual Training for Artisans." He pointed out that manual training was neither manual labor nor trade training. Manual training was purely educational, differing from the methods of ordinary workshops or of a trade school. Manual training is an excellent thing for an artisan, as for everyone else. It makes the learning of a trade a very simple and easy matter if one wishes to be a mechanic for a time, but the graduate of a manual training school will probably not become an artisan at all in the ordinary sense. The records show that a great majority of graduates earn more money and achieve greater success in other occupations. If you wish your boy to be a mechanic do not send him to a manual training school; if you do he may become an architect, an engineer, a lawyer or a physician. Prof. Thos. W. Mather read a paper on "Manual Training in High Schools." He said that two courses of instruction should generally be given in a manual training High School. The first should afford preparation for colleges or schools of technology, while in the second it may be assumed the boy's school education must end upon graduation. During the third year a period every day should be given to elementary mechanics experimentally treated. In the fourth year an equal time should be devoted to applied mechanics treated in the same way. This may profitably include heat, steam and the steam engine, the strength of materials and stresses in structures.

Dr. C. S. Murkland read an interesting paper on "Agricultural Colleges, their Function, with Relation to Engineering."

At the close of the meetings the following officers were elected — President, J. P. Johnston, Washington University; vice-president, T. C. Mendenhall, Worcester Pyrotechnical Institute, and Harry W. Tyler, Massachusetts Institute of Technology; secretary, Albert Kingsbury, New Hampshire College of Agriculture; treasurer, J. A. Flater, Purdue University, Indiana.

THE AIR SHIP IS HERE.

On the 13th of August, at Vancouver, an object was seen in the sky travelling eastward, which had all the appearance of an air ship, and what was said to be a balloon was reported at three or four different points in Manitoba and the territories. At 12.40 on the morning of the 16th, C. W. Spencer, superintendent of the Eastern Division of the C.P.R., was sitting with Thos. Hay, his assistant, in the observation car of the train which had left Port Arthur for Sudbury, and as they were approaching Gravel River, and sat admiring the clear starlit heavens, they saw, in the words of Coleridge, "a something in the sky." There was a large white light, and at an angle above it on the left a red light and at a like angle on the right a white light. The object appeared to be about half a mile above the earth, and when first seen was at an angle of 30° to 40° above the horizon. It seemed to be moving with the wind about 30 miles an hour, as the train was running at 45 miles an hour, and the object appeared to fall in their wake. When they had watched it about three minutes the train turned inland from the shore of Lake Superior, and before it was hid behind the bluffs it tilted and turned inland, apparently following them up valley. As it turned the red light became blue, and there was disclosed in line with the main headlight a row of four lights terminated by a circle or ellipse of a dozen lights, in the midst of which was the dark body of the air ship. The light had the steady clearness of electric or acetylene light, and Mr. Spencer and Mr. Hay could form no other opinion than that it was an air ship, and if the object seen at Vancouver was the same it must have travelled to this point, 2,100 miles, at the rate of about 700 miles a day. It is quite possible that some inventor has set to work quietly and unostentatiously, and thus get his claims in practice before announcing his discoveries to the world; and if so this northern country, with the wide reach of Lake Superior, may shortly learn that air navigation has been first accomplished in Canadian territory.

THE LATE F. B. ROBB.

The late F. B. Robb, secretary-treasurer and manager of the Robb Engineering Co., Limited, who was drowned while bathing at Fox Harbor, N.S., July 20th, was born at Amherst, Nova Scotia, on the 8th of November, 1857. His father, the late Alexander Robb, was one of the pioneer manufacturers of Nova Scotia, having established in 1845 the business which has since developed into the Robb Engineering Co. Mr. Robb was educated at the Cumberland County Academy and Dalhousie College, Halifax, afterwards being specially fitted for his work by a short experience in banking and a commercial college course at St. John. In 1876, when nineteen years of age, he, with his brother, D. W. Robb, now president and engineer of the company, took the full management of the extensive business to which he labored up to the time of his death.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain to Canada for July, 1896 and 1897, and the seven months ending July, 1896 and 1897.

	Month of July		Seven months ending July.	
	1896	1897	1896	1897
Hardware and cutlery	£ 41,032	£ 53,[illegible]	£ [illegible]	£ 2[illegible]
Pig iron	2,41[illegible]	[illegible]	[illegible]	[illegible]
Bar, etc.	[illegible]	[illegible]	[illegible]	[illegible]
Railroad	[illegible]	[illegible]	[illegible]	[illegible]
Hoops, sheets, etc.	[illegible]	[illegible]	[illegible]	[illegible]
Galvanized sheets	[illegible]	[illegible]	[illegible]	[illegible]
Tin plates	[illegible]	5,[illegible]	[illegible]	[illegible]
Cast, wrought, etc., iron	[illegible]	[illegible]	[illegible]	[illegible]
Old (for re-manufacture)	[illegible]	[illegible]	[illegible]	[illegible]
Steel	[illegible]	[illegible]	[illegible]	[illegible]
Lead	[illegible]	[illegible]	[illegible]	[illegible]
Tin, unwrought	[illegible]	[illegible]	[illegible]	[illegible]

FIRES OF THE MONTH.

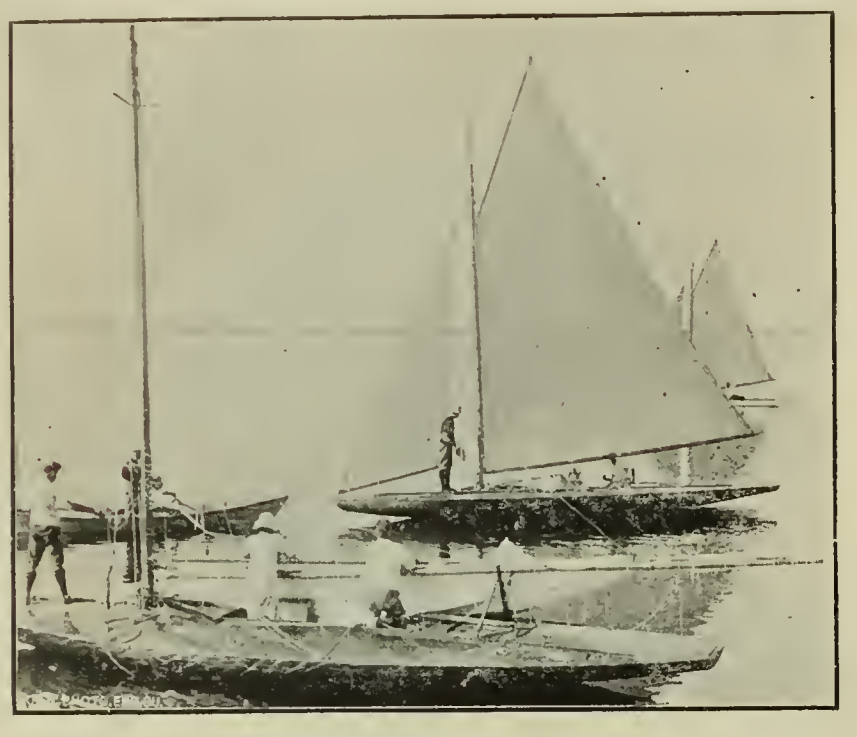
July 29th.—Sash and door factory of H. & P. Smith, Dorchester, N.B. Total loss.——Aug. 4th.—E. Moseley's tannery, St. Hyacinthe, Que. Loss, about $[illegible].——Aug. 5th.—The C.P.R. round house at Revelstoke. The company lost a consolidated engine, a rotary snow plough and engine No. [illegible].——Aug. 15th.—J. T. Harvie's saw and lath mills. Loss $[illegible].——Aug. 15th.—The Hamilton and Toronto Sewer Pipe Co.'s Works, in Hamilton, Ont. Loss $[illegible].——Aug. 16th.—The Laurie Engine Works, Montreal, roof destroyed and pattern shop damaged.——Aug. 16th.—An explosion in the dust box in the Cobban Mfg. Company's Works, Toronto, caused $[illegible] damage. Fully insured.——Steamer "Acacia" and steam launch "Athena" burned at wharf, Hamilton, Ont. Loss on "Acacia" $[illegible]; on "Athena" $4,000.

Captain Michael T. Fell, of the Rochester, N.Y., fire department, and son-in-law of Wm. Johnson, Peterboro, Ont., has invented a swivel joint hose nozzle which has received very favorable notice.

The Wallaceburg, Ont., Glass Company has resumed operations, with a full force of blowers. The company has orders ahead. It is estimated that $[illegible],000 will be paid in wages during the present season.

THE SEAWANHAKA CHALLENGE CUP.

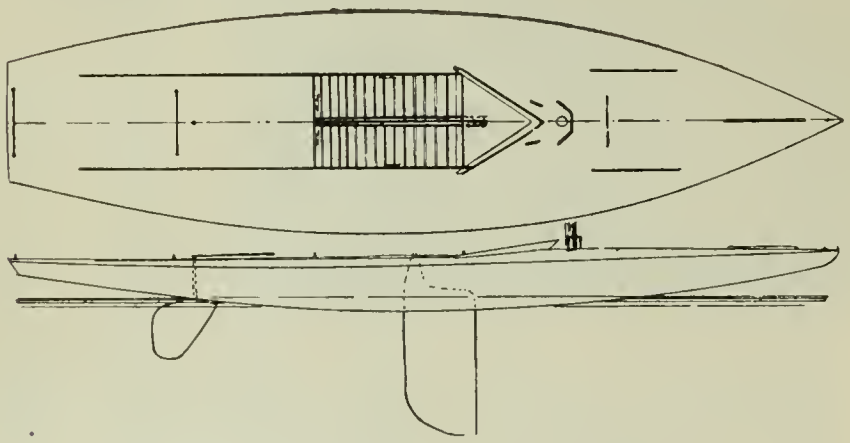
For the second time in succession the Canadian yacht designed by G. H. Duggan, C.E., of the Dominion Bridge Works, has won the Seawanhaka International Challenge Cup. Last year Mr. Duggan



GLENCAIRN II.

gained his victory on salt water at Oyster Bay, this year it was on Lake St. Louis. The race this year was between Mr. Duggan's new yacht "Glencairn II." and the Seawanhaka Corinthian Yacht Club's representative "Momo," three times over a triangular course; total distance 12 miles; the winner to gain three out of five races. The following were the official measurements of the two boats:

	Glencairn II.	Momo.
Length over all	32.15 ft.	29.50 ft.
Overhang forward	8 3 ft.	6.02 ft.
" aft	6.40 ft.	5.31 ft.
L.W.L.	17.43 ft.	18.17 ft.
Sail area	489.10 sq. ft.	456.32 sq. ft.
$\sqrt{\text{Sail area}}$	22.12 ft.	21.35 ft.
Racing length	19.77 ft.	19.76 ft.



DECK AND SHEAR PLAN OF GLENCAIRN II.

The first race was sailed on the 14th August, in a slight breeze, and was won by "Momo," the "Glencairn" having had a hole stove in her bow at the start. On Monday, 16th, the "Glencairn" won easily in a spanking breeze, and on the two following days repeated her victory, thus securing to Canada the trophy for another

G. H. DUGGAN, C.E., WINNER OF THE SEAWANHAKA CUP.

year. The race was well and fairly sailed, and the stiff gales of the last three days were such as to make the contest a trial of real seamanship. In the final race Mr. Duggan's handling of his yacht, disabled as she was with a torn sail, was admirable.

RESISTANCE MEASUREMENTS.

In electrical measuring instruments few are more important than the Wheatstone bridge, and this has come to be realized to such an extent that to explain the advantages of this method of measuring resistances, or testing for broken circuits, short circuits and grounds, would be a waste of time and space. The main requirements of such apparatus are, first, that it should be portable, convenient and easy to operate, and durable; second, that it should be accurate under all general conditions; third, it must have a wide range; fourth, it must be low in price.

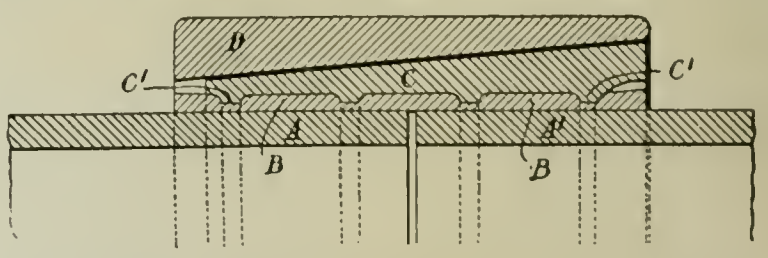
About a year ago, the Whitney Electrical Instrument Company, believing that apparatus combining all of these conditions was not easily obtained, commenced a line of experiments, and in presenting the Whitney Portable Testing Sets, they offer the result of several months study, and an instrument that they claim has been thoroughly tried and every weak feature eliminated. In size it is 8 x 5 x 5½ inches, and it weighs five pounds. They guarantee it accurate to within one-fifth of one per cent., and with its resistances as low as one-tenth of an ohm can be measured. The rheostat arms are formed by the two outside bars, and have a range of from one ohm up. The central bar comprises the two bridge arms, and by plugging or unplugging the ratio coils in these arms, the value of the rheostat coils are divided or multiplied as desired. The galvanometer is designed with especial reference to being extremely sensitive and quick to respond with a small current, and in the measurement of low resistances one cell will be found ample.

These testing sets are made in two styles. With batteries for outside testing and where access to batteries is not convenient, and without batteries for school and laboratory work. The type containing batteries is furnished with six cells so arranged that from one cell up to the full battery can be used. The instrument is also provided with two binding posts, so that battery from an external source can be used if desired. The battery is of the chloride of silver type. The cells will, it is said, last several months in constant service, and may be renewed at a very small expense. The instrument is mounted in handsomely polished mahogany, and all metal parts are substantially finished in lacquer.

The resistance is of special alloy, carefully made and highly insulated. There is, the makers claim, no appreciable temperature error under general conditions. At the present time, these sets are being made in a variety of ranges up to five megohms, and it is the intention of the manufacturers to build them with still greater capacity very soon.

RING JOINT FOR PIPES.

In the August number of THE CANADIAN ENGINEER we referred to a new system of jointing pipes which was being tested at the works of the Kingston Locomotive and Engine Co. The following description will assist our readers in forming an estimate of the value of this process.



This joint is applicable to steel, iron and other pipes, particularly water and gas mains of large diameter.

It consists of two or more parts, namely:—1. A packing strip; 2, a circumferential tapering wedge, and 3, a sleeve or compression ring. The joint will be best understood by reference to the accompanying figure which shows in sections, taken parallel with the axis of the pipes, the sections being taken through one side only of the pipes. In

all the drawings *A* and *A1* are the pipes, *B* the packing strip, *C* the taper wedge, and *D* the compression ring.

The packing strip *B* formed of any suitable compressible material, such for example as lead or india rubber, is laid circumferentially round the joint of the pipes. It may be of any width considered desirable, and of rectangular, curvilinear, corrugated or other section, and its edges or ends may overlap or may butt together, either parallel with, or diagonal to the axis of the pipes. It may be in one or more pieces, and though generally a loose piece, it may, if preferred, be fastened either to the taper wedge, which is placed over it, or to one of the pipe ends. Or it may be run into place after the pipes are put together. The taper wedge *C* consists of a band or ring, preferably of steel or other metal, formed in one piece, in which case it is split, or of two or more segments, which may have the ends or edges butting or overlapping, parallel with or diagonal to the axis of the pipes. Packing may be used at the divisions to make them tight if necessary. The wedge may be of any desired length or thickness, and may be plain. Internally it is usually of equal diameter at both ends, but it may be formed with a taper. Externally it is conical or tapering, thus forming a circumferentially tapering compressible wedge or ring, which contracts in diameter under the pressure of the compression ring or sleeve *D* which is forced over it in making the joint. The compression ring *D* consists of a rigid hoop or sleeve, preferably of steel or other metal, of any suitable length or thickness, having its inner surface tapered to correspond with the external taper of the wedge *C*. The inner surface of *D* may be grooved or recessed to reduce the area of its bearing surfaces on the outside of *C*.

The joint is made by forcing the compression ring *D* over the split wedge *C*, thus contracting it, and compressing the packing strip *B* around the ends of the pipes *AA1*. Conversely the joint may be loosened or taken apart by withdrawing the compression ring *D*.

Any suitable means may be employed for forcing the compression ring upon the wedge, such for example, as hammering it on, or using screw, hydraulic, or other power. Clamps or bands may be used placed temporarily round the pipes, and drawn together by screw bolts; two or more hydraulic presses suitably mounted in a suspension cradle may be employed for closing the joint. After the joint has been made the packing strip may, if desired, be caulked into an annular space between the pipes and the ends of the taper wedge.

Referring to the accompanying drawing we see a joint in which the ends of the pipes are butted one against the other. The wedge, *C*, is provided with four projections, *C1*, internally, so as to put pressure on the packing strip, *B*, at those points. This joint is the invention of D. J. Russell Duncan, C.E., who has fully protected it by patents.

Mr. Duncan has also during his visit to Canada had set up at the Kingston Locomotive and Engine Co.'s works a rolling-down machine for producing Williams' patent wedge-joint pipes. By this process steel pipes are made from flat steel sheets, rolled cold by machinery, without the aid of furnaces or heating agencies, and at a cost for labor, it is claimed, less than the cost of producing pipes by other processes. The manufacturer of steel pipes on Williams' patent longitudinal wedge-joint system is dependent upon very simple machinery. Plates, as they are received from the plate mills, are cut to the desired width in a shearing or slitting machine. This machine shears plates perfectly parallel, at the rate of 15 feet per minute. After passing through this machine, they enter the nibbing machine, in which the edges of the plates are bent inwards for about a quarter of an inch. From the nibbing machine the plates pass on to the skelp machine, in which they are bent into semi-cylindrical form. Two plates are employed in the manufacture of each pipe. These plates are bound together by means of two bars of steel, rolled to a channel section. These bars are placed internally in the pipe and the edges of the nibbed plates fit into the recesses in the channel bars. The pipe is then firmly bound by two concavo-convex bars, which run the entire length of the pipe and fit into the channel between the nibbed edges of the plates. The pipe when fitted together ready for rolling down is shipped on a cast-iron mandrel on the rolling-down machine, which exerts great pressure upon the two wedges, and flattens them in such a manner that they are securely locked in the channel bars, and bind the edges of the nibbed plate so effectively that the pipes, when tested, are found to be absolutely water-tight. The wedge bars, rolled down in this manner, may be said to resemble a continuous longitudinal rivet.

The Vessot Grain Grinder attracted much attention at the Montreal Exposition, and will be entered at the Ottawa and Toronto Exhibitions. The machine is one of the best in the market, having been awarded a gold medal and diploma at the World's Fair, Chicago, 1893. S. Vessot & Co., Joliette, Que., are the manufacturers.

COMPRESSED AIR.

At pages 343 346, vol 2, and page 317, vol 1, of The Canadian Engineer, descriptions are given of the Taylor Hydraulic Air Compressor, now at work at Magog, Que., in operating six engines, showing the printing machinery of the Dominion Cotton Mills Company, using 155 h.p., giving a pressure of 52 lbs to the square inch Though very little has yet been done to call attention to the merits of C. H Taylor's invention, yet its simplicity and the efficiency obtainable from a given fall of water are so great that manufacturers, miners, capitalists, scientists, and every one who may by accident have heard of it, are writing for any available information from all parts of America Great Britain, and many European countries

In the meantime, the company has been securing and perfecting its patents in all important countries and already has sold the rights for British Columbia, Washington, Montana and Idaho, for a large sum, and a company has been formed with head office at Spokane, Wash., to instal the system in those parts. This company is becoming active, and arrangements are about completed to instal a plant at Ainsworth, B C, to develop 500 horse-power for use in the mines within a radius of five miles.

The plant at Magog has now been tested in all seasons and the system has proved itself faultless, giving the company using it great satisfaction, both in its working and in its economy. No one can see where there is any probability of the plant wearing out or repairs being required during an ordinary life time, unless it be to increase the size of the plant to give more power.

All will accord to steam, electrical and water power their full value, allowing to each a field where they are supreme. All these are now well developed and their usefulness generally understood, yet compressed air, with its possibilities, is as yet a sealed book even to most scientists, though all are accustomed to the usual expression, "Compressed air is the coming power." It has come, and the world is indebted to Mr. Taylor for his ingenious invention, which transforms a water-power into compressed air at a minimum cost and maximum efficiency. Some of the advantages claimed for the system are as follows:—

1. It transforms a water power of any head into compressed air of any desired pressure without the usual intermediate losses

2. Low heads of water, which would otherwise be useless for the production of power, can be used to advantage by this compressor.

3. The air is compressed at a constant temperature, viz.: that of the water, and is consequently delivered at a temperature generally below that at which it is taken into the compressor. Hence there is no loss of power by contraction in volume.

4. The air during compression is freed by the water of the greater part of its moisture, it being delivered so dry that it is impossible for condensation to take place during either its transmission or subsequent expansion.

Condensation and freezing of moisture in mains, etc, one of the chief obstacles to the use of compressed air, is entirely overcome by this method of hydraulic compression.

5. This compressor will maintain a constant pressure, even under a fluctuating head, without change of efficiency.

6. The compressor is entirely automatic in its action

7. Owing to the absence of moving machinery the duration of a plant is almost without limit.

8. The absence of moving machinery dispenses with skilled labor, as practically no attendance is required.

9. When the compressed air is not used at the same rate as it is generated, it accumulates and may afterwards give, for a limited time as much as double the average power developed by the compressor, without change of pressure. This storage of power is effected by displacement of water, and not by an increase of pressure

10. A plant does not require to be covered by a building.

With the question solved as to the compressing of air economically, as it is by the Taylor system, it is only reasonable to expect that progress in rapid strides will now be made by engineers and others to perfect the motor or other apparatus which uses the air, as hitherto all attention was given to the compressor and none to the motor, whilst in the use of steam all attention was given to the perfecting of the engine and not the boiler. The general public can find but little information on compressed air; the most accessible being such as is found in catalogues, in words such as "if you don't buy our compressor you can't use compressed air," in effect condemning unintentionally compressed air. Thus, also, has advancement in its use been retarded.

Again, how little knowledge is abroad regarding the transmission of air power; or, going further, how few engineers or scientists know anything of importance regarding its transmittable qualities? As it can only be transmitted through pipes, there is of course some decrease of pressure from friction, and hence some loss of power at the delivery

end, but far from as much as most imagine. Catalogues have done injury here to the cause of compressed air, though unwittingly, by printing tables showing the loss of pressure due to the friction of air in pipes, the intention being to show the size of the most suitable pipe for given cases of transmission. And while telling about loss of pressure, they fail to tell that that loss does not necessarily mean to the same extent a loss of power. Take a distance of, say, 10 miles, and the fact is said to be that there is but very slight loss of power if the pipes be of proper size If gauge pressure be, say, 80 lbs., or 95 absolute, on entering the pipe, and 70 lbs., or 85 absolute, at the other end, there would be a loss of a little above 10 per cent. in absolute pressure; but there would be an increase of volume of 11 per cent. to make up for the loss of pressure; thus the loss of available power would be less than 3 per cent. With higher pressure, still more favorable results could be shown. Such a power produced as economically as by the Taylor system, must surely be a "coming power."

Mining Matters.

QUICKSILVER is said to have been discovered just outside of Dartmouth, N.S., recently.

THE Elginfield Oil and Gas Co. struck a fine gas well near Wallacetown, Ont., recently.

THE Dardanelles Mine, Nelson, B.C., will soon have a steam plant air compressor in place, it is said.

THE smelting works in Hamilton, Ont., are receiving ore from the Coe Hill iron mine in Hastings county, Ont.

THE Ruth mines, Sandon, B.C., will put in a concentrator, and the Slocan Star Company has surveyed a site at Cody for one to treat the ore from their Noonday property.

THE long-standing trouble between the town of Kingsville, Ont. and the Natural Gas Company that has been supplying the town, has been settled by the town buying out the plant of the company for $27,000.

GOLD has been discovered on the farm of James McLean, about two and one-half miles above McDonald's Corners, Lanark County, Ont. Experts are at work to ascertain whether it can be worked to advantage.

THE Pictou Charcoal Iron Company has given a lease with option to purchase their blast furnace and plant at Bridgeville, N.S., to the Mineral Products Company, which intends operating the deposit of bog manganese near Hillsboro.

THE Canadian Gold Fields Co. has ordered from the Ingersoll-Sergeant Drill Co. a seven-drill compressor, 80-horse power steel machine drills, Ledgerwood hoisting engine and all necessary adjuncts, to be delivered by the Drill Company, ready for operation, in 45 days from August 7th.

A CONTRACT has been let for the machinery for a 100-ton concentrator and a double tramway 8,500 feet long for the Montezuma Mining Company, Kaslo Creek, B.C. The cost of the tramway and concentrator complete will be about $45,000. The mill will be erected under the supervision of T. L. Mitchell.

A VERY important discovery of gold-bearing rock is reported on what is known as the Diamond property, in the tenth concession of Madoc, Ont. D. E. K. Stewart has found a vein, four feet wide, of mispickel, with quartz showing free gold. The mispickel assayed several hundred dollars per ton. The vein has been stripped for several hundred feet, and a shaft has been sunk to a depth of 10 feet.

A MEETING of the British Columbia Association of Mining Engineers was held in New Denver, B.C., recently. Among others present were: H. West, A.R.S.M., A. J. Colquhoun, M. E. F. Monckton, F.G.S, A. Dick, Captain Morrish and M. A. Bucke. It was decided to affiliate with the Canadian Mining Federation, also to make arrangements for a grand rally and banquet in Vancouver next January. The association aims to be representative of the mining engineers and mine owners of British Columbia, and has upwards of 80 members, all of whom are men of standing in the profession.

SOME changes in the British Columbia mining regulations are looked for at the next session of the legislature, as the outcome of Prof. Carlyle's recent tour of the mines. The present Act is most liberal, in that it admits of the recording of locations before performing any development work whatever; there is a disposition on the part of claim owners to shirk the annual assessment falling due within the year following the location of claims by a system of re-locating. The effect of this is that large areas are staked off and no work is performed beyond the driving of the stakes. In one district one man was holding sixty claims. The regulations will, therefore, be made more stringent.

THE Trail, B.C., smelter produced the first gold brick, Aug. 11th.

VERY rich discoveries of gold are reported from Indian Head, near Sherbrooke, N.S.

THE Dominion Coal Company shipped about 150,000 tons of coal up the St. Lawrence in July.

A SAW MILL and stamp mill will, it is said, be built at once at Bell City, Seine River district, Ont.

N. H. STEVENS, Dr. Holmes and others have organized a company to supply Chatham, Ont., with natural gas from Kingsville.

A. W. CARSCALLEN has ordered from the Wm. Hamilton Mfg. Co., Peterboro, Ont, for the Belmont gold mine, a ten-stamp mill.

AT Deloro, Ont., the Canadian Gold Fields Company has increased its force to two hundred men, and they are working day and night.

DR. W. L. GOODWIN and F. J. Cope have recently held prospectors' classes in connection with the School of Mining and Agriculture in Madoc and Bancroft, Ont.

P. HEIMINCK & Co. propose to establish a smelter at Edmonton N.W.T., on condition of receiving a bonus of $10,000 and certain exemptions.

GOLD is reported to be found in paying quantities in Ottawa county, on the farm of Louis Dozios, on the north shore of the Ottawa River, about twelve miles above Aylmer, Que.

THE North-Western Mining and Development Company is said to have struck a silver mine in the township of Barrie, Frontenac county, Ont. After going down twenty-five feet the vein was seven feet wide. The ore assays from $56 to $300 per ton.

JAMES KING, Quebec; W. Yuile, Montreal; J. de Labroquerie Tache, St. Hyacinthe; J. R. Tache, Quebec, and L. Gendreau, St. George's, are to be incorporated as the Central Quebec Gold Fields Company; capital stock, $6,000; head office, Quebec.

A COMMITTEE, consisting of Oliver Durant, J. B. McArthur, and J. F. McCrae, appointed by a mass meeting of the citizens of Rossland B.C., has prepared a memorial to lay before the Dominion Government, protesting against the imposition of an export duty on British Columbia ores.

THE British Admiralty has ordered sixty tons of coal from the newly-discovered veins on the west coast of Newfoundland, to be used by the warship "Buzzard" as a test. If the quality of coal is satisfactory St. John's will, it is said, be created a dockyard and naval station.

FEODOR BOAS, managing director of the Danville Asbestos Company, and J. N. Greenshields, Q.C., of Montreal, are at present opening up a new mine about three miles from Danville, Que., on the Richmond road. Some years ago a vein of galena was discovered and the samples submitted to an analyst showed 63 per cent. copper and $13 silver per ton.

PROF. A. P. COLEMAN, Ontario Government geologist, recently returned from a tour through the mineral regions of Western Ontario, and reports some interesting facts. The area in the Wahnapitae region in which gold mines of importance have been found, is comparatively small. "I think," he says, "it will be much more extensive as soon as prospecting goes on. At present some of the townships are closed to prospectors pending an enquiry into the character and extent of the timber resources which exist there. Several new finds have been made at Mosher Bay, one of the upper arms of Lake Manitou One of a very promising character belonged to Gasse & Leullier, two Frenchmen. There was a very large body of quartz which would average seven feet in width, and the owners had followed it along the face of a hill for half a mile, and had opened it for perhaps 25 or 35 feet. I saw a number of specimens while there that were quite rich. In the Saw Bill Region a number of finds of very rich quartz, containing free gold, were made before I left there," Dr. Coleman explained. Those were to the north of Lynx Head Falls, and prospectors were to be encountered everywhere. It is probable that a considerable amount of gold will be found in that district, judging from appearances.

TEXADA ISLAND is a veritable wonderland. By the steamer "Maude" the owners of the Nutcracker claim on Texada Island received a number of specimens from their claim which in richness and apparent permanency eclipse anything yet received from the far-famed Texada. The specimens were taken from the bottom of the shaft being sunk by McCloskie & McDonald. The depth is about 22 feet, and the ledge opened out four feet wide. The gold is of a very bright color, resembling Australian gold. The specimens also give evidence of being rich in silver. Experts pronounce it the most valuable of the many developments of Texada Island, insomuch as the gold is in solid rock and not in the surface crevices, the same as the Lorindale and other claims. They have only struck the foot wall, and, although the ledge has been opened four feet, it has not yet reached the hanging wall. The owners are Mrs. Edwin Gough and Robert Evans of the Nanaimo

Hotel, and J. W. Stirtan, superintendent of the Nanaimo waterworks. The Van Anda "Copper Queen" shaft is taking out some fine rich variegated copper ore, which should from all appearances run high in value. The Raven mine has now got a well-defined vein of payable ore and will soon be making regular shipments. Operations at the Kirk Lake gold mines are in full swing. The new hoist plant and pump are expected to arrive within the next few days. The directors are negotiating now for a twenty-stamp mill which is expected to be in operation not later than October 1st. The Kirk Lake Company have over 1,200 tons of ore on the dump ready for milling which from tests made from shipments to San Francisco and Tacoma shows an average value from $22 50 to $64 per ton. The Surprise mine is erecting hoist plant, and will sink to the 250 foot level. The Silver Tip mine shipped 100 sacks of ore on the steamer "Comox" and the Victoria-Texada mine shipped 100 sacks of ore on the steamer "Maude" to Victoria. A notable fact is that so far all veins have improved most remarkably at 100 feet depth, and the general outlook is that the island will ere long be a busy hive of workmen, as soon as a little more development work is done.—*Nanaimo Free Press.*

JAS. BREEN, manager of the Le Roi smelter, recently gave the following reasons for the selection of Northport as the site for the new plant: "One of the principal reasons is that in the operation of a smelter of 300 tons capacity it will require approximately 40 tons of limestone daily to flux the excess of silica contained in the Le Roi ore. This limestone now costs the B. C. S & R. Company, whose smelter is located on the Columbia River at Trail, $3.50 per ton. The Le Roi Company at Northport can deliver a superior quality of limestone to any found in Kootenay in their works for 25 cents a ton, saving approximately $50,000 a year in this item alone. We can lay down coke in Northport for $2.50 per ton less than in Trail, and in our smelting operations we will use about 45 tons of coke per day, making a saving in this item of $45,000 per year. We will also save $1.50 per ton on coal, of which we will use about 20 tons per day, making a saving of $10,000 a year. The cost of our plant will be reduced 5 per cent. by reason of cheaper building material and freight rates, without considering the innumerable articles entering into the construction of a smelter which have to pay duty, notwithstanding that the machinery comes into Canada duty free. On renewals and repairs there will be a monthly expense of $2,500, on which there will be a saving of $2.50 per ton in freight and 30 per cent. in duties as against any point on this side of the line. The saving in this item alone will approximate $15,000 a year. We will save at least $1.50 per ton on outgoing freight. On a basis of 20 tons per day this will amount to $15,000 per year. Taking these items and others which I have not mentioned, for instance the saving of $1 per cord on wood, this represents roughly a saving of $150,000 per year, or $1.50 per ton of ore smelted. It is patent to everyone that this is just so much saved to the producers of ore in the Rossland district, and were an export duty placed on ore this saving would not be effected. It should also be borne in mind that besides establishing competition in smelting, the erection of the Northport plant secures a freight rate on ore of 75 cents per ton, instead of $2, as heretofore charged."

IN an interview with a representative of the Toronto *World*, J. A. Caldwell, proprietor of the famous Sultana mine, gives the following details about the mine. The main shaft is now down 360 feet, with 1,000 feet of drifting distributed over five levels. The vein being lenticular in form, has narrowed and at times almost pinched out; but the lead is never lost. Up to the present time the mine has been operated by a plant consisting of a few light drills and a ten-stamp mill, which latter, by the way, has come in for a lot of criticism by certain experts, for the stated reason that it did not save as much of the gold as it should, a considerable percentage passing off in the tailings; but Mr. Caldwell said that he is getting from 75 to 80 per cent. of the gold in his ore in the batteries and on the plates, and 10 per cent. more in the concentrates, or from 85 to 90 per cent. altogether, which is an extremely high and satisfactory average. Machinery of high capacity is now being installed; the capacity of the mill is to be increased five times. At present 30 head of stamps are being put in place, but room and power are being supplied for 50 stamps. The new boilers, shafting, etc., are equal to the calls of a 50-head mill. The mill is to be very complete, with the latest and most approved Gates crusher, batteries, vanners, etc., and will have a daily capacity of 80 tons of ore. A new chlorination plant will handle the concentrates. In the new mill, which is being put up on the side hill beside the old one, gravitation will be taken advantage of in conveying ore from the shaft. In order to keep this big mill going skips and a 75-horse power hoisting engine are being installed, together with pump and a compound duplex air compressor, capable of furnishing power to 10 or 12 drills. Only eight, however, will be run this fall. There is a large quantity of ore in the five levels ready for stoping, so that, with the extra drills, there will be no difficulty in getting out the necessary 80 tons per day. From the new shaft house, now in course of erection, the rock will be run on a level tramway to the crusher. The mine has a water power system and an electric light plant of its own. Most of this machinery is made in Canada, being furnished by the Jenckes Machine Company of Sherbrooke, Que., and the Canadian Rand Drill Company.

Electric Flashes.

ACTON, Ont., will probably have electric light in the near future.

AN electric light plant will be placed in the Jackson & Cochrane foundry, Galt, Ont.

THE Lanark county electric railway bonus by law, which was voted on recently, in Perth, Ont., was defeated by a majority of over fifty.

THE Connecticut Telephone and Electric Company, of Chicago, U.S., have been making enquiries in reference to a telephone franchise in Toronto recently.

I. J. GOULD, owner of the present electric light service in Uxbridge, Ont., will probably extend his plant by the addition of incandescent lighting to that now in service.

CARLETON PLACE, Ont., is in favor of the Lanark County Electric Railway. A public meeting to discuss the scheme was held recently, and it was unanimous in support of it.

J. A. MCLEAY, M.D., of Watford, Ont., has purchased from the Royal Electric Company a 500 light alternator and the necessary transformers, and is installing an incandescent plant in the town of Watford.

G. A. CLARE, of Clare Bros. & Co., stove and furnace manufacturers of Preston, Ont., says that much of the business activity of that town is due to the freight facilities provided by the Galt, Hespeler and Preston Electric Railway.

A PECULIAR accident resulted in the burning out of the motor used to open and close the swing bridge at the beach, Hamilton, Ont., not long ago. The watch chain of the man in charge dropped in such a way as to short circuit the motor with the result mentioned.

THE Exeter, Ont., Electric Light and Power Company, recently organized to take over the lighting business in Exeter, formerly operated on a small scale by Captain Howard, has placed an order with the Canadian General Electric Company for a 1,000-light, single phase alternator, of the standard iron-clad armature compound-wound type.

LA Compagnie Electrique, of Chicoutimi, Que., has increased the lighting capacity of its plant by the addition of another 40 K. W. "S. K. C." Generator, which it has purchased from the Royal Electric Co. This addition has been made necessary owing to the growth of their power transmission work.

PAMPHINE BOIVIN, of the town of Baie St. Paul, Que., has received a franchise from the corporation of that town for electric lighting, and the Royal Electric Company is now installing for him an electric lighting plant consisting of a 500 light "S.K.C." dynamo, with the necessary transformers and material.

THE Kootenay Electric Company, of Kaslo, B.C., who have a large water power near the town, and purpose using the same for power and lighting, have placed their order with the Royal Electric Co for a 75 K. W. "S.K.C" generator, and the necessary transformers and motors. The water will be carried in by a 42-inch stave pipe flume about 1,300 feet long, which will run to the power house.

SOME years ago the Dominion Government claimed duty on all the rails brought into Canada for street traffic purposes, and compelled payment of the same after they had got a decision in their favor in the Canadian Supreme Court. The Toronto Railway Company carried the case to the Privy Council, and got a judgment in their favor, and the money paid in by them was refunded by the Government. Recently the Toronto Railway Company made a motion before the Privy Council to have the interest allowed on the duties paid by the company, and judgment was given in favor of the motion, so that the Government will be compelled to pay a further sum of $10,000 or $11,000 to the railway company.

THE new Electric Locomotive recently shipped from the works of the Canadian General Electric Co. to the Hull Electric Co., is the largest machine of the kind so far constructed in Canada. The motive power will be furnished by a four-motor equipment of G. E. 51 motors, having at normal current input a capacity of 80 horse-power each. The trucks are of the McGuire "L" pattern, with steel rim wheels. The body, which differs in operation and detail from the first locomotive supplied to the Hull Electric Company, was built for the Canadian General Electric Company by the Crossen Car Company of Cobourg, Ont.

THE Bell Telephone Co. is putting in an up-to-date switchboard in the Ingersoll office.

THE new power-house for the Sherbrooke Street Railway Co. is being built by Loomis & Sons, Sherbrooke, Que.

THE Fenelon Falls Lumber Company has purchased a 250 light incandescent plant from the Canadian General Electric Company.

THE Yarmouth, N S., Street Railway Company has purchased a 45 kilowatt generator from the Canadian General Electric Company.

THE Canadian General Electric Company is installing a 150-light incandescent plant for the estate of Ross Bros., Buckingham, Que.

I. MATHESON & Co., Limited, New Glasgow, N.S., have purchased an incandescent lighting generator from the Canadian General Electric Company.

THE Montreal Street Railway Company has placed an order for fifty additional G. E. 1,000 motors with the Canadian General Electric Company.

THE Canadian General Electric Company is installing an incandescent lighting machine for the Toronto Paper Company at the Cornwall, Ont., mills.

THE Canadian General Electric Company is constructing a 75 kilowatt steel frame, direct connected, direct current generator, for McGill University, Montreal.

THE British Columbia Mills Trading Co., Vancouver, B.C., is lighting its mills by electricity, the plant being furnished by the Royal Electric Co , Montreal.

DORAIS & DOBBIN is the style of a new firm of electrical contractors, 4 Beaver Hall Hill, Montreal, which makes a specialty of equipping electric lights and bells.

THE Canadian Pacific Railway Co. has recently largely increased the staff in its car shops at Perth, Ont., and is working overtime. The Royal Electric Co. is installing a plant in the shops.

CHAMPOUX & BROS , Disraeli, Que., are installing a 650 light alternating current dynamo, which they purchased from the Royal Electric Co. They are lighting the town and their mills.

THE Doherty Organ Company, Clinton, Ont., requiring an increased dynamo capacity, has placed an order with the Canadian General Electric Company for a 200 light incandescent machine of the Edison type.

R. SMITH & Co., Sherbrooke, Que., have recently installed a 100-light plant in the Montague Paper Company's new steam saw-mill, at Lake Megantic, Que., and are also building a 200 light electric plant, alternating current, for Dr. Edgar, North Hatley, Que.

THE Canadian General Electric Company has received an order for a 2,000-light, single phase alternator for Revelstoke, B.C. This machine, which will be of the standard iron-clad revolving armature type, compounded to secure automatic regulation, will be used to supply incandescent lighting in Revelstoke and vicinity.

THE CANADIAN ENGINEER had the honor to receive an invitation to attend the 19th annual Rhode Island clam dinner tendered to the electrical fraternity by Eugene F. Phillips, president of the American Electrical Works, Providence, R.I., at the Pombam Club, August 21st. It is unnecessary to say we regretted our inability to attend.

THE Canadian General Electric Company is installing a 75 kilowatt monocyclic generator for Kilmer, Cowan & Co., of Southampton, Ont. This machine, which will be operated from a water power, conveniently located, will supply current for incandescent lighting and power for the two neighboring towns of Southampton and Port Elgin, Ontario.

ON August 20th the Kingston Street Railway was handed over from 2 to 10 o'clock p.m. to the nurses of the Kingston General Hospital, who acted as conductors and collected the fares in aid of the Hospital. Quite a handsome sum was realized, and kindly comments were made on the philanthropy of B. W. Folger, the proprietor of the road, which took this form.

THIS is a time of peace, says a Maritime Province exchange, but the defences of Halifax harbor are to be strengthened. A powerful electric searchlight will be placed in the fort at York redoubt, at the entrance to the harbor, and a new battery for quick-firing guns built at Point Pleasant, making four batteries within gunshot of each other, though hidden in the woods of the public park.

THE corporation of Magog, Que., has awarded the Canadian General Electric Company the contract for a 1,000-light single phase alternator and other apparatus for their new incandescent lighting plant. The street lighting will be done by 64-50 c.p. incandescent lamps, which are expected to furnish a much more satisfactory street lighting service than their equivalent of arc lamps.

THE patent rights for Canada of a new storage battery which is now in use, after ten years test, by the Electrical Power Storage Co., London, are advertised for sale in this issue of THE CANADIAN ENGINEER.

THE Aylmer Electric Light and Mfg. Company, Aylmer, Ont., is installing an extensive incandescent lighting system. It has awarded the contract for the apparatus required for the plant to the Canadian General Electric Company. The generator will consist of a 60 kilowatt, 1,000-light standard single phase alternator of the revolving iron-clad armature type, compounded to secure automatic regulation.

Personal.

PIERRE POITRAS, contractor, Chicoutimi, Que., died not long ago.

JOHN R. ALLAN, O.L.S., is to be the engineer for O'Neil & Ferguson on their contract in the Crow's Nest Pass Railway.

ROBERT BARROW, son of City Engineer Barrow, Hamilton, Ont., has gone to the Klondike with a Government exploration party.

J. G. SIBBALD, who has represented the Carnegie firm, of Pittsburg, for some time in Montreal, died recently in New London, Conn.

R. E. L. BROWN, W. H. Young and J. R. Stephens have opened an office in Victoria, B.C., and are doing business as mining engineers.

WHILE bathing in the St. Lawrence, at the Montreal plumbers' picnic, held August 14th, A. Lebel, machinist, was accidentally drowned.

H. SMITH, engineer at Wortman & Ward's foundry, London, Ont., was recently seriously burned while throwing refuse paint into the furnace.

THE death was announced by cable recently of Mrs. A. Galt, mother of John Galt, C.E., of Toronto, which took place at Kilmarnock, Scotland.

R. CARR HARRIS, C.E., formerly professor of engineering in the Royal Military College, Kingston, Ont., has started for the Klondike, taking his two sons with him.

PATRICK G. ALEXANDER represented the *Engineer*, London, England, at the meeting of the British Association for the Advancement of Science, in Toronto, last month.

CAPTAIN P. G. TWINING, R.E., instructor of engineering at the Royal Military College, Kingston, Ont., was married to Miss Louise Daly, of Napanee, Ont., last month.

As a result of changes in the engineering department of the Grand Trunk, William Crawford, Hamilton, Ont., will be master of buildings and bridges, with headquarters at London.

JOSEPH NICHOLSON, foreman of the tin department, has been appointed superintendent of the tin, stamping, re-tinning, galvanizing, japanning, enamelling and machine shops at the McClary Manufacturing Co.'s works, London, Ont.

W. W. LA CHANCE, formerly of the firm of Gregg & La Chance, architects and engineers, Cleveland, Ohio, has returned to Hamilton, Ont., his native city, to resume his profession as architect, after spending ten years in the United States.

T. R. DEACON, C.E., has formed a partnership with J. E. Switzer, O.L.S., C.E., late assistant city engineer for Ottawa, Ont., and the new firm of Deacon & Switzer will carry on the business of engineering and surveying at Rat Portage, Ont.

C. F. HANINGTON, C.E., Shediac, N.B., has been appointed assistant engineer of the Crow's Nest Pass Railway. Mr. Hanington has had a large experience in railroad engineering, and was a member of the staff on the original survey of the C.P.R.

W. T. JENNINGS, C.E., late city engineer of Toronto, who was formerly with the C.P.R., has been engaged by the Dominion Government to go out immediately with a party and furnish a report on the best means of getting into the Klondike country by railway over an all-Canadian route. At the same time he will take a look at others, and in fact at all available routes, so as to supply information upon which the executive may rely.

FREDERICK PRESTON RUBIDGE, for thirty years architect of the Public Works Department, Ottawa, and one of the most eminent members of his profession in the Dominion, died at his residence recently, in Montreal, in the ninety-second year of his age. The deceased was superannuated in 1872, previous to which he was actively employed on the parliamentary and departmental buildings, and superintended the construction, midway up Parliament Hill, of the picturesque path known as the "Lovers' Walk." The first few years after retiring from the civil service Mr. Rubidge spent at Ottawa, removing then to Hamilton, and some fourteen years ago to Montreal.

GRANVILL C. CUNNINGHAM was presented with an address by 800 employees of the Montreal Street Railway Co. previous to his leaving for Birmingham, Eng.

A. C. STONEGRAVE has been appointed general agent of the freight and passenger departments of the Central Vermont Ry. in Canada, a promotion upon which he has received many congratulations. His offices will be in the Board of Trade Building, Montreal, P.Q.

ROBERT MITCHELL, president of the Robert Mitchell Co., Limited, brass founders, died at the age of 76 in his home, in Montreal, Sept. 1st. He was a native of Scotland, being born at Prestonpans. He was in business in Montreal from 1851, and has always been one of the most prominent business men of the city, though his modesty prevented his taking the part in public affairs that those who knew him felt he was qualified to fill.

PETER MCMICHAEL, for many years the popular assistant manager of the Toronto branch of the James Robertson Company, Limited, has been promoted to be manager of the St. John, N.B., branch of the firm. On the eve of his departure a few of the many business firms, who, by contact, had recognized his sterling qualities, presented him with a costly diamond ring and illuminated address. The following firms were represented at the presentation: Booth Copper Co., Limited, per G. H. Booth; Goderich Organ Co., Alex. Saunders; Miln-Bingham Printing Co., James Miln; Montreal Rolling Mills Co., John Irving; James Morrison Brass Mfg. Co., James Morrison; John Ritchie Plumbing Co., Limited, A. N. Richardson; Toronto Foundry Co., H. W. Anthes; Toronto Radiator Co., Adam Taylor; Toronto Hardware Co., J. H. Paterson; Toronto Steel Clad Bath Co., A. G. Booth; Toronto Standard Manufacturing Co., J. J. Torrance; Gurney Foundry Co., Limited, W. N. Garrick.

MAJOR HENRY FULLERTON PERLEY, M. Inst. C.E., who died at Bisley, Eng., July 17th, from bronchitis, was a resident of Ottawa. He was born in St. John, N.B., in 1831. He entered the public service of New Brunswick in the year 1848, continuing until the summer of 1852 on exploratory surveys for a proposed system of railways. In 1852 he was engaged by Pets, Betts & Brassey on surveys in the province of New Brunswick and Nova Scotia, and employed by them during 1854-55-56 on the construction of the Grand Trunk Railway between Montreal and Brockville. In August, 1856, he again entered the service of New Brunswick as resident engineer on the construction of the E. & N A. Railway between St. John and Shediac, remaining until the completion of the line in December, 1860. Between 1861 and 1863 he was engaged in private practice. In May, 1863, he entered the service of the Government of Nova Scotia, continuing as provincial engineer until August, 1865; then resigning to fill the position of agent for Keth, Waring Bros. and Lucas, contractors for the construction of the Metropolitan Extension (underground) Railway, London, England. At the completion of this engagement, in 1870, he returned to New Brunswick and took charge of the works in connection with the improvement of the freighting facilities of the Government Railway in that province, and the construction of the deep water terminus and extension line at St. John. In May, 1872, he was appointed engineer in charge of harbors, etc., in the Maritime provinces for the Department of Public Works, which position he held until the close of 1879, when he was appointed chief engineer. This position he held up to 1891.

Railway Matters.

IT is said that 27 bridges will be required on the Crow's Nest Pass Railway between Medicine Hat and Lethbridge.

THE Ottawa and New York Railway is not to be compelled to put a draw span into its St. Lawrence bridge at Cornwall, in spite of the objections of the shipping interest to any obstructions in the navigation.

WM. RUSSELL, C.E., is now engaged in locating the line of the Pembroke Southern Railway, which will connect Pembroke with the Ottawa, Arnprior and Parry Sound Railway. The distance to be built is twenty miles.

THE Quebec Central Railway Company is commencing to relay a considerable portion of the main line between Sherbrooke and Quebec with new seventy pound steel rails. The Carnegie Steel Company are supplying the rails.

THE employees of the Pacific Division of the C.P.R. recently presented H. Abbott, late general superintendent, with a massive silver punch bowl, and a pair of candlesticks and a purse of money. The presentation was suitably acknowledged by Mr. Abbott.

WE are requested to announce that the next annual convention of the Association of Railway Superintendents of Bridges and Buildings will be held at the Brown Palace Hotel, Denver, Colorado, on Tuesday, Oct. 19th. The secretary is S. F. Patterson, Moberly, Mo., from whom the programme can be obtained.

SOME of the contracts let for the construction of the New York and Ottawa Railway are Grading, Peppard & Balch, Minneapolis, Minn.; rails, Johnston & Co., Johnstown, Pa. masonry for bridges, Soovsmith & Co., New York, iron work on bridge, Phœnix Construction Company. The contract for the bridge requires that it shall be ready for construction trains on November 15, and for general traffic on January 1, 1898.

THE C. P. Ry have taken out a permit to build a $14,000 engine shed at the foot of Simcoe st., Toronto, and shops for light repair will be built. The making up of trains will be done along the water front, so that many engineers, firemen, baggagemen and others will be moved from Parkdale, where such work has been hitherto done

THE Canada Atlantic are building a line, about six miles in length, from Lacolle, in the county of St. Johns, Que., to a place called Alburgh Springs, in the State of Vermont. This includes a bridge across the Richelieu, the latter being built by day work. The contractor for the road is Mr. Fauquier, who built a good portion of the Parry Sound extension of the Canada Atlantic. Mr. Mitchell, of Kingston, is the sub-contractor, and the new line will in all probability be completed by October next.

ABOUT 100 miles of the Crow's Nest Pass road is already under contract, and track-laying began at Lethbridge on the 29th July, and was commenced at McLeod, 40 miles westward, early in August. The second fifty miles have been divided into sections of from five to ten miles long, and awarded to Messrs. McArthur, Buchanan, Strevel Keith and Bowels, all of Winnipeg; McGillivery, of Vancouver, and Hugh Mann, of Rossland. It is more than probable that the first hundred miles will be completed before the end of the year and another section well under way.

GENERAL MANAGER CAMPBELL, of the Dominion Atlantic Railway of Nova Scotia, has made the following changes in the staff. The resignation of the resident manager, K. Sutherland, went into effect at the end of July, and P. Griffin is appointed to the position. Mr. Sutherland was in addition to superintendent the road's engineer. Edward M. Stewart, C.E., who came out from Scotland two months ago with Mr. Campbell, is appointed chief engineer.

THE Montfort Colonization Railway Company are pushing the extension of their line to Arundel, Que. The railway has already been built from St. Sauveur Junction, on the Canadian Pacific, to a distance of 21 miles, and now 12 miles additional are being built, bringing the road to Arundel, and making a total of 33 miles. Unfortunately, when the Montfort road was started, the directors decided to make the gauge three feet, which necessitates a great deal of difficulty in the transhipment of freight at St. Sauveur Junction. A movement is on foot to have the line changed to the standard gauge.

J. M. SHANLY, engineer of the Atlantic and Lake Superior Railway Co., reports that the work of ballasting the road from Metapedia to Caplin, 80 miles, is progressing and two trains a day are running. The contract for grading from Caplin to Paspebiac, 20 miles, has been awarded to Perrault & Gervais, who will finish their work this fall. There will be two bridges, one over the Big Bonaventure River, 300 feet long, and the other over the Little Bonaventure, 60 feet, both of which will be constructed of stone, with an iron superstructure. The proposed extension to Gaspe Basin will not be near as heavy work as was to be anticipated

Marine News.

THE Inland Navigation Company, capital $13,000, of Charlottetown, P.E.I., is applying for incorporation.

RODOLPH E. LEMIEUX, M.P., and Robert Lindsay, of Gaspe, have arranged with the Department of Commerce for placing a weekly service for freight and passengers on the St. Lawrence, between Quebec and Gaspe. There will be only one steamer to commence with.

AT the meeting of the shareholders of the Canada Shipping Company held in Montreal recently, the offer of Peterson, Tate & Co. to purchase all the steamships of the old Beaver line, to take over the office and the whole of the business of what is known as the Canada Shipping Company, was accepted.

THE Department of Public Works has just finished at Sorel a large dredge, called "The Laurier." It will be escorted by a new steel tug, to which Mr. Tarte has given the name of "St. Johns and Iberville," the division which he represents. The Minister is negotiating for a plot of land at Sorel on which to erect additional new workshops.

THE C.P.R. will add to its fleet on the Columbia an express boat for carrying passengers, mail and express. The keel of the new boat was recently laid at Nakusp. It is thought this boat will be the fastest in any of the inland waters of the North West. It is expected to make the time from Trail to Arrowhead in 24 hours, equal to 19 miles an hour. She will be christened "The Flyer."

To meet the opposition of the line from Alexandria Bay to Montreal, the R. & O. Nav. Co. have placed three extra steamers a week on that route, the extra boats reaching Montreal an hour before the regular boat. The company contemplate building two new palace steamers to run between Toronto and Prescott, and to be built with turbine propellers of the type referred to in a late issue. Such boats would be capable of making 35 to 40 miles per hour, and would do the trip from Toronto to Kingston in from four to five hours if no stops were made at lake ports. No decision has yet been come to on this matter, but meanwhile the regular boats will be altered and improved, adapting them better for tourist travel.

RECENT English papers contain accounts of the launching of two magnificent ships for the Elder-Dempster Company of Liverpool and Montreal. One was launched at Wallsend-on-Tyne, and christened the "Monarch." She and her sister ship the "Milwaukee" are the largest freight steamers yet built in England. Her dead weight cargo capacity is 11,500 tons, while her measurement cargo is over 18,000 tons, besides 700 tons of bunker capacity. Her length is 483 feet, beam 56 feet, depth 42 feet 3 inches to the shelter deck. She has 12 steam winches for handling cargo, is lighted by electricity, and the cattle stalls, etc., are of the latest type. The other boat, the "Montrose," was launched at Middlesborough. She has a dead-weight capacity of over 8,000 tons, is 460 feet long, 52 feet beam and 30.7 feet deep. She is fitted up with cold storage apparatus for dairy produce, etc.

LITERARY NOTES.

The 41st annual report on the sewage and water supply of St. John, N.B., has been compiled by Wm. Murdoch, C.E., engineer of the department. The daily average water supply for St. John is 4,903,100 gallons, being 138.2 per head of population, or deducting that used by manufacturers, railway and shipping, etc., 124 gals. per head of east side population. During the year 79 new services were laid at an average cost of $24.64 each. The total pipeage of the city is 95.15 miles. There are 174 water meters in use. During the year there were 4,400 feet of sewers built, at a cost of $13,852. One of these, which was a difficult work, will be referred to again in this journal.

We have heard so much of old London lately, that a sketch of our Canadian London will be specially interesting by way of contrast, and therefore the new history of London, Ont., compiled by Archie Brem-ner, and published by the London Printing and Lithographing Company, is both timely and valuable. This work contains 136 pages 9 x 12 inches, and is illustrated by over 300 half tone engravings, including a map of Western Ontario. The illustrations alone would almost portray the history of the city, but the writer has given a most graphic and entertaining narrative of the evolution of a modern Canadian city from its log cabin beginnings, in 1826, down to the Jubilee celebration of this very year, and embracing almost every phase of its civic life and all its institutions. The book is free from advertisements, and is creditable alike to the author and the printers and publishers. Sample pages and prospectus will be sent to any one interested.

We have to thank Chevalier Chs. Baillairge, librarian of the Geographical Society of Quebec, for a copy of the transactions of that society from 1893-97, which make a volume of 340 pages in all. This society is doing a most important work in showing the greatness and value of our unknown northern regions, and deserves the encouragement they are now seeking from the Government. Among the contributors, besides M. Baillairge, are Dr. Robt. Bell, A. P. Low, John Bignell, H. O'Sullivan, and others well known in connection with exploratory work, and several engravings and maps accompany the papers. The work throws a good deal of light on the regions about Hudson and James' Bays, and will be specially valuable now that those regions must soon be opened up by means of railways. We hope to refer to the work at greater length in another issue.

The annual report of the several departments of the city government of Halifax, N.S., has reached us. It is a neat pamphlet of over 300 pages, and gives details of all the departments of the city government. The engineering departments contain many indications of the skillful management of F. W. W. Doane, C.E., the city engineer.

A very attractive pamphlet describing the city of Hartford, Conn., and its principal industries has been published, describing, among other concerns, the Skinner Chuck Co. The sketch shows that the business of this company has developed very rapidly since its establishment in 1887, a development evidently due to the superiority of the firm's products. The company have several patents on their chucks, which are turned out on the most modern machinery by skilled workmen. The Skinner Chuck Co. have an extensive trade all over the continent, including Canada, and will be glad to furnish information about their specialties to those interested.

We have received a pamphlet from the International Correspondence Schools, of Scranton, Pa., which contains 1,000 letters written by friends of the school to testify their appreciation of the advantages it offers.

We notice from the calendar of the Kingston, Ont., School of Mining that the entrance examinations for the session 1897-98 begin Sept. 16th.

Industrial Notes.

THE school trustees of Oxford, N.S., have decided to erect new school buildings to cost $7,950.

THE town engineer of St. Stephens, N.B., has been authorized to invite tenders for sewers, for which the sum of $5,000 has been appropriated.

THE E. B. Eddy Co., of Hull, will put in a separate system of waterworks, having 40 hydrants, with a pumping force of 5,000 gallons per minute.

THE Joliette Lumber Company's mills at St. Gabriel de Brandon, is handling pulp wood at the rate of 50 cords barked per day, besides cutting 50 to 60 thousand feet of lumber daily.

A LARGE number of elevator owners in Manitoba and the North-West generally are looking into the possibilities of gasoline engines, and several have already been ordered, it is said.

DRUMMOND, MCCALL & Co., Montreal, who have the contract for St. Lambert's waterworks system, will employ from 100 to 150 men until the completion of the contract in November.

A. E. WHITEHOUSE has commenced business at 684 Craig street, Montreal, as a general machinist and engineer, giving special attention to gas engines, printing machinery, bicycle work and model making.

THE St. Lawrence Foundry Co., Toronto, is now building a full line of fire hydrants, gate and check valves, and some waterworks appliances not hitherto made in Canada. A further reference to the firm's products will be made in our next issue.

A. CUSHING & Co. offer to erect a pulp mill of a capacity of twenty tons per day, near their big saw mill at the St. John Falls, if the city of St. John will supply the water free. The mill would cost $150,000, and will pay out $60,000 a year in wages.

THE third annual meeting of the shareholders of the Taylor Hydraulic Air Compressing Company, Ltd., was held at the offices of the company, 183 St. James street, Montreal, last month, and the following were elected directors: Samuel Carsley, president; Joseph B. Fair, vice-president; George Durnford, William H. Campbell and R. L. Murchison.

MCOUAT & MCRAE founders and machinists, Lachute, are getting very busy on orders for their specialties. This firm make a patent frost dog and patent timber gauge for lumber manufacturers, both of which are coming into general use as the best thing of the kind yet invented. They also make a "stuff" pump for paper mills, which is now used by all the leading paper and pulp mills of Canada. These and stationary fire pumps and friction clutches are among the special lines made by this progressive firm.

HAMELIN & AYERS, of Lachute, Que., are building a large dam across the North River below their present woolen mills. Forty men are employed on the dam, which is 360 feet wide, 28 feet high from the river bottom, with a base of 84 feet. It is of the "beaver" type and gives a head of 23 feet at the dam, or by carrying the water across a peninsula formed by a bend in the river the head can be increased to 33 feet. The work will be finished this month, and the owners will sell or lease the power for manufacturing purposes.

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The Canadian Engineer

VOL. V.—No. 6. TORONTO AND MONTREAL, OCTOBER, 1897. PRICE, 10 CENTS $1.00 PER YEAR.

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. III.—(*Continued.*)

ARTICLE 10.—EASEMENT ON TRANSITION CURVES.

In article 6, under "Curve Resistances," is given formula (8), which indicates the amount that the outer rail on a curve should be elevated above the inner one, but, as the two rails on the adjoining tangents are of the same height at any given point, the question arises as to the best manner of effecting this change of conditions so as to lessen any shock to passengers or rolling stock, or indeed to entirely abolish it. Practice has determined that, where there is distance enough to permit, the curve super-elevation ought not to be lowered more than ½ inch per rail length (30 feet), or (*e.g.*) on a 10° curve of ½ inch super-elevation per degree, this would require a distance of 300 feet. The most common practice in America has been to bring the full elevation to the ends of the curve, and then lower it on the tangents. This, evidently, will act so that as a train approaches a curve the play of the wheels (½ inch to 1 inch) will all be at the outside, *i.e.*, the wheels will press against the inner rail, and then, at the instant the curve is reached, there will be a lurch to the outside in assuming the natural position, in passing round a curve, of the front wheel of each truck against the outer rail.

Some have tried to remedy this by lowering the elevation partially on the curve, and partially on the tangents, which merely divides one shock into two smaller ones. The true remedy lies in not making an abrupt change in horizontal alignment from a curve to a tangent or *vice versa*; but in so arranging the track at each end of a curve, that commencing with a curve of infinite radius, this radius is gradually decreased, *i.e.*, the curve is sharpened, and at the same time, the elevation of the outer rail is increased, keeping this elevation at each point just sufficient for the curvature until a junction is made with the main circular curve, with a curvature equal to it, and with a full elevation, and having kept an equipoise between curve and elevation at each instant, all lurches and shocks will be avoided. That this is the only true and rational solution, is proven by the fact that practical trackmen, unguided and even hindered, often, by engineers' rigid centre stakes, but recognizing the evil and its remedy, have introduced crude easement curves wherever they could do so, and improved the situation as much as possible; but as the tangent and main circular curve were both fixed in position by construction, all that could be done was to flatten the ends of the curve at the expense of the adjoining portions, which were thus made sharper than the main curve itself, and formed more or less of elbows in the track, often 2° or 3° sharper than the main curve.

Now this can be avoided by moving the curve inward bodily, or by changing the position or direction of the tangents, or by sharpening the whole curve slightly, any of which will permit of the introduction of proper easement curves at the two ends of the circular curve. Many methods have been advocated for putting in these easements, the endeavor being to simplify the process, in point of time and mental effort, and still preserve the essentials. Some of these are: (*a*) A succession of short pieces of curves of decreasing radii. (*b*) A modification of (*a*) in the form of a spiral. (*c*) A modified quadratic parabola (Holbrook spiral). (*d*) A modified cubic parabola. As any one of these can, when once understood, be easily laid out in the field, it is only necessary to decide on the most adaptable and suitable one for all cases to be met with, and study its theory and actually use it, after which its seeming difficult nature and laborious methods of application, so long dreaded by many railway engineers, will be found quite simple, and capable of rapid manipulation.

Almost all engineers are agreed that transitions are intrinsically necessary, and on European and the best American tracks their use has become established: the chief objections to their general adoption here have been the deeply rooted ideas that they were difficult to apply and too refined for ordinary use, but as speeds are being increased and competition is keener, they are beginning to be used by all roads of any importance because the consequent easier riding caters to the travelling public and also because the wear and tear on the rolling stock, and the difficulty of keeping the ends of curves in proper line, are thereby much decreased.

(*a*) This first class of transitions does not require any

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

demonstration. Some engineers put 100 feet or 200 feet of a curve of larger radius at each end of the main curve, and trust to the trackman for the rest, others introduce a series of short arcs of decreasing radii, say 30 feet of 1° curve, 30 feet of 2° curve, etc., leading up to the main curve at the rate of 30 feet per degree; this necessitates placing the transit every 30 feet, is a tedious and clumsy method, and the result is that the trackmen fuse one portion into another until it is, to all intents and purposes, the same as a spiral. It does not admit of ordinary calculation or manipulation unless modified as in the next paragraph.

(*b*) In "The Railway Spiral," by Searles, is given a complete analysis of the transit work necessary to lay down a succesion of short circular arcs, beginning at zero, and having equal lengths of arcs of equal increments of sharpness, *e.g.*, 20 feet of 1° curve, 20 feet of 2° curve, etc., up to any required sharpness. Tables of deflections are worked out, so that any point of change of curvature can be used as a transit site, and any point of change can be established from any other point of change by transit deflections. Methods of conversion are also given, so that from one foundation series other deflection tables may be determined suitable for spirals of more or less rapid sharpening. The subject is well discussed and thoroughly worked out for all probable conditions, but as it does not present that same flexibility and simplicity of use which the cubic parabola possesses, its continued use is doubtful. It has served its day, and, where used, furnished the trackmen with a succession of hubs, really the ends of arcs of increasing sharpness, but practically points on a spiral very suitable for an easement curve.

(*c*) The Holbrook spiral (quadratic parabola). The idea involved in this easement curve is that the *vertical* acceleration of the train, as it passes around it, should be uniform. If we let t represent horizontal distances (with train moving at a uniform speed) in the general formula $s = \frac{1}{2}$ ft.^{2}, then, in order to keep f (acceleration) constant, the distance, s, (*i.e.*) the amount which the train rises above the normal tangent level, must vary as the (distance)^2, and as the elevation should always bear a constant ratio to the degree of curve at each point, therefore the degree of curve on this required spiral must vary as the square of the distance from the zero of such a curve, (*i.e.*) the radius of curvature, at each instant, must vary *inversely* as the distance from the zero of the curve

A curve of such a nature has the equation $y = (f)x^4$ to represent it, and is a curve very flat at the beginning, but increasing very rapidly in curvature. This easement curve sacrifices the correct horizontal alignment, as will be seen in the next paragraph, for a supposed refinement in the vertical one; it is quite difficult to apply except in most ordinary cases, as the formulæ used involve expansions of sine and cosine, does not prevent any advantage over the cubic parabola, and is not so adaptable or easy to manipulate in the case of any problems having special conditions (*d*).

The Cubic Parabola.

This curve as adapted to transitions to railway circular curves has been studied pretty thoroughly. Howard, Armstrong, and others have written pamphlets on it; the transactions C.S.C.E. for 1891, 1892 and 1893 have several papers and discussions on it, and its probable originator, the late A. M. Wellington, determined very simple equations for it which were published in the *Engineering News*, January and February, 1890.

It is this last demonstration that will be now given to which will be added necessary developments. The curve required for a suitable transition is one which starting with an infinite radius or D (degree of curve) = O. at the $B\ T\ C$ (A Figs. 13 and 14) has a degree of curve at each point in direct proportion to its distance from the $B\ T\ C$ until it joins and becomes tangent to the main curve at C, and is, at that point, of the same degree of curvature as the main curve.

The cubic parabola $y = (f)\,x^3$ approximates to these conditions.

Let $A\ M\ C$ (Fig. 13) be the cubic parabola, $A\ C^1$ tangent to it at A, and $I\ C$ the radius of the D degree curve with which it connects at C, having there a common tangent $I^1\ C$.

Figure 13

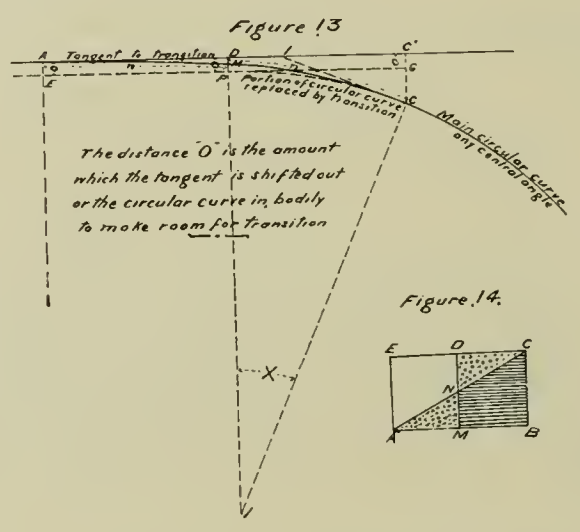


Figure 14.

Figure 15.

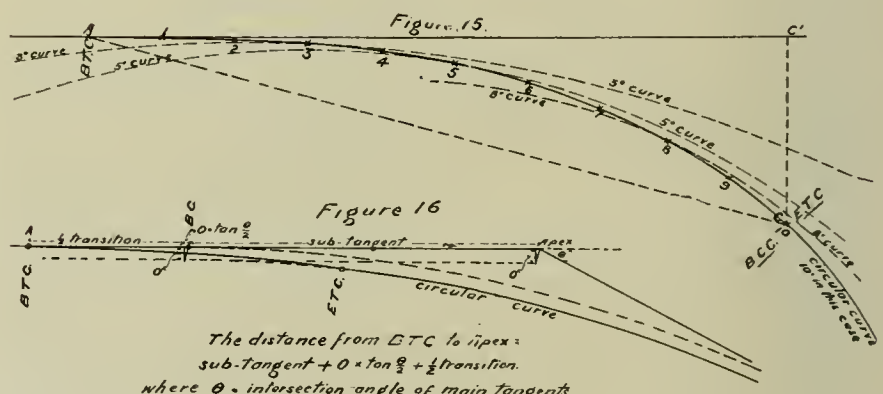


Figure 16

Figure 17.

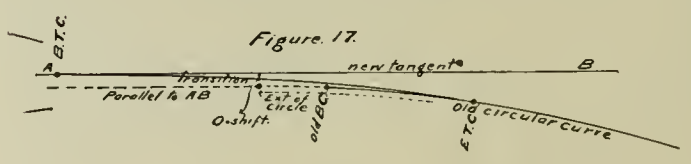
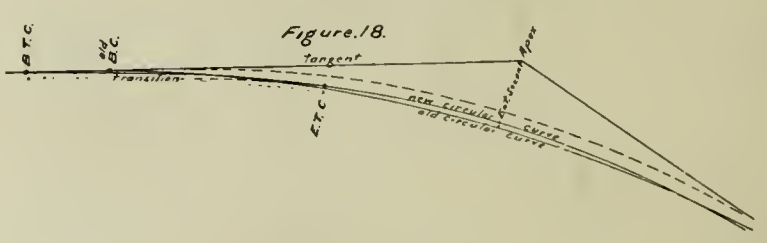


Figure 18.



Let X be the central angle of the circular arc $P\ C$, which is changed into the transition curve $A\ M\ C$.

Let $E\ P\ G$ be tangent to $P\ C$ at P and therefore parallel to $A\ C^1$, and make $C\ C^1$ perpendicular to $A\ C^1$.

Also in Fig. 14, let vertical heights represent degrees of curvature at any point and horizontal distances, measurements along the cubic parabola.

Then the rectangle D B will represent graphically the circular arc $P\ C$, and the triangle $A\ B\ C$ represent graphically the cubic parabola $A\ M\ C$, and from this diagram and Fig. 13 we may readily conclude:

(1) Because the total angles of the arc $P\ C$ and the transition $A\ M\ C$ are equal, therefore the area of the triangle $A\ B\ C$ must equal the area of the rectangle $D\ B$, and therefore a transition curve is always twice as long as that portion of the circular curve which it replaces.

(2) Because the triangles $A\ M\ N$ and $C\ D\ N$ are equal and similar, therefore the angular deflections or offsets from the tangent to every point in $A\ M$ (Fig. 13), and

from the circular curve outward to every corresponding point in the equal distance $C\ M$, are equal in magnitude and distribution, and $\therefore\ D\ M$ is equal to $M\ P$ and half of $D\ P$ (Fig. 13). Hence the offset or shift $D\ P\ (= O)$, and the transition curve $A\ M\ C$ bisect each other at M.

(3) The offsets from a tangent to a circular curve vary as the square of the distance from the tangent point (nearly), or to formulate it O varies as $n^2\ D$.

Where O = offset from tangent,

n = distance of the offset from the tangent point,

D = degree of curve,

but by our definition of a transition curve the degree of curve at any instant also varies as n. Therefore in a transition curve of this nature O varies as $n^2 \times n = n^3$.....(12), and also by paragraph (2). If we have a given offset from tangent to circular curve at $D = D\ P\ (= O)$, then the offset to the transition curve at a distance m from A is equal to $\left(\frac{m}{n}\right)^3 \frac{O}{2}$ where $n = \frac{1}{2}$ length of transition $= A\ M = M\ C$. And, in the same way, measuring back from C along the curve toward P at any distance, m the offset outward from the circular curve to the transition curve $= \left(\frac{m}{n}\right)^3 \frac{O}{2}$ ..... (13)

The equation to the cubic parabola can now be established in terms of the offset O and $\frac{1}{2}$ length n. let $y = C\ x^3$, but when $y = \frac{O}{2}, x = n$, therefore $C = \frac{O}{2} \times \frac{1}{n_3}$

and $\therefore y = \frac{O}{2n^3}\ x^3$ ..... (14)

(4) because by equation (12) offsets to a transition curve vary as cube of distance from origin, therefore in Fig. (13) $C\ C^1 = 8 \times D\ M = 4\ O$, and therefore $G\ C = 3\ O$.....(15)

Now, for very small angles, $G\ C = P\ C \times \text{Sin}\ \frac{X}{2}$ (nearly), and $P\ C = 2 \times I.C \times \text{Sin}\ \frac{X}{2}$ (nearly), therefore by substitution we get

$G\ C = 3\ O = 2\ I\ C \times \text{Sin}^2\ \frac{X}{2}$ (nearly), but $I\ C = \frac{5730}{D}$ (D = degree of curve), and $\therefore\ O = \frac{3820}{D} \times \text{Sin}^2\ \frac{X}{2}$, and

$\text{Sin}\ \frac{X}{2} = \sqrt{\frac{O \times D}{3820}} = .01618\ \sqrt{O \times D}$ ..... (16)

from which we can get X, having O and D; or otherwise, since $n = \frac{X}{D}$ (evidently), and for small angles $\text{Sin}\frac{X}{2} = .0087\ X$ (in degrees).

$\therefore$ substituting in (16), we get

$X = \frac{.01618}{.0087}\ \sqrt{O \times D} = 1.86\ \sqrt{O \times D}$ ..... .(17)

and $n = \frac{1}{2}$ length of transition $= 1.86\ \frac{\sqrt{O \times D}}{D} = 1.86 \sqrt{\frac{O}{D}}$ .....(18)

This can also be put in the approximate form, $O = \frac{n^2}{6R}$ .....(19)

Where R = radius of the curve.

Equations (12) to (19) give such relations between X, n, O and D as will enable any length of transition curve to be put in for any degree of curve.

(*e.g.*) Let D = 10° curve, and O = 10 feet.

Substituting in (18) we get, n = 186 feet, or the transition is $2n$ = 372 feet, which is somewhat longer than is needed.

(*e.g.*) Let X = 15°, and D = 10° curve.

Then, $O = \frac{15 \times 15}{(1.86)^2 \times 10} = 6.5$ feet, and $n = 100 \times 1.86 \sqrt{\frac{6.5}{10}} =$ 150 feet, which latter could have been determined directly.

Also $\frac{O}{2} = \frac{6.5}{2} = 3.25$ feet, and any other offset will vary as cube of distance from A; that at the quarter points being, for instance, $(\frac{1}{2})^3 \times 3.25 = .41$ feet.

A most usual length of transition is 30 feet per degree of curve, which permits of the super elevation being lowered at $\frac{1}{2}$ inch per 30 feet = 1 rail length, which is a most usual amount.

Now, although these equations enable us to put in transitions by offsets, if we have for instance, the tangents already in place, and can move the main curves inward bodily so as to permit the requisite "shift" O, which is very useful if, on construction, the rigid curves and tangents are found already in place, and offsetting is the quickest method to use—still, we also wish to be able to put in transitions as a regular part of location, and not as an afterthought, and to do so it is necessary to determine methods of locating such curves by transit deflections from the beginning, end, or intermediate points.

Any small angular deflection from a meridian to any point varies as $\frac{\text{offset}}{\text{distance}}$, or in other words the natural tangent of any small angle is its circular measure.

Now referring to equ tion (12) and Fig. (13) any offset from the tangent $A\ C$ to the transition curve varies as the cube of the distance from A.

$\therefore$ angular deflections to the transition curve from tangent $A\ C$, using A as origin, vary as $\frac{\text{offset}}{\text{distance}} = \frac{(\text{distance})^3}{\text{distance}} = (\text{distance})^2$... .... (20)

Also in Fig. (13) $\frac{G\ C}{A\ C} = \frac{1}{2}\ \frac{G\ C}{P\ C} = \frac{1}{2} \times \frac{X}{2} = \frac{3 \times O}{2 \times n}$ (evidently)

$\therefore\ X = \frac{6 \times O}{n}$ but the angle $C^1AC = \frac{C\ C}{C\ A} = \frac{4 \times O}{2 \times n} = \frac{2 \times O}{n}$

$\therefore$ the angle $C^1\ A\ C = \frac{1}{3} \times \frac{6 \times O}{n} = \frac{1}{3}\ X$ ..... (21)

Equations (20) and (21) enable us to determine any deflections to the transition curve from the point A; (*e.g.*) let a 10° curve have a transition curve 300 feet long then $X = \frac{n}{D} = \frac{300}{2} \times \frac{1}{10} = 15°$.

$\therefore$ by (21) the angle $C^1\ A\ C = 5° = 300' =$ deflection from tangent at A to the end of the transition, and by equation (20) the deflections to each 30′ intermediate point are :

1st 30 ft. point $\left(\frac{30}{300}\right)^2 \times 300' = 03'$

2nd " $\left(\frac{60}{300}\right)^2 \times 300' = 12'$

3rd " $\left(\frac{90}{300}\right)^2 \times 300' = 27'$

4th " $\left(\frac{120}{300}\right)^2 \times 300' = 48'$

etc., etc., etc., etc.

This series of deflections from the origin A, continued as far as necessary, may be called *a foundation series*, and is the basis of all deflections forward or backward from any point. We must now, in order to fix on intermediate deflections, with the transit also at some intermediate point, look on a transition curve, thus : (See Fig. 15). Suppose it to be stopped at 1, then it is a transition curve to a 1°

curve; if stopped at 2, it is a transition curve to a 2° curve, etc.; therefore if the transition *does* continue past the points 1, 2, 3, etc., we may consider it to be composed of two parts: 1st, a 1°, or 2°, or 3°, etc., curve, according to circumstances. 2nd. Plus the *foundation series* of 3′, 12′, 27′, 48′, etc., beginning at the point considered, and continuing forward to any desired extent, and the transition curve deflections are the sum of these two. Also, in the same way, the transition curve deflections looking backward, with transit at any point, are those of a certain degree of curve corresponding to this point, minus the same *foundation series;* (e.g.) suppose the transit to be at the point 3, with the vernier at zero, and line of sight tangent to the curve, then the vernier readings to each intermediate point would be—

$$(A) -\left(\frac{90}{100}\times\frac{180'}{2}-27'\right)= -0^\circ\ 54'.$$

$$(1) -\left(\frac{60}{100}\times\frac{180'}{2}-12'\right)= -0^\circ\ 42'.$$

$$(2) -\left(\frac{30}{100}\times\frac{180'}{2}-3'\right)= -0^\circ\ 24'.$$

(3) 0° 0′ = 0° 0 position of transit.

$$(4) +\left(\frac{30'}{100}\times\frac{180'}{2}+3'\right)= +0^\circ\ 30'.$$

$$(5) +\left(\frac{60}{100}\times\frac{180'}{2}+12'\right)= +1^\circ\ 06'.$$

$$(6) +\left(\frac{90}{100}\times\frac{180'}{2}+27'\right)= +1^\circ\ 48'.$$

$$(7) +\left(\frac{120}{100}\times\frac{180'}{2}+48'\right)= +2^\circ\ 36',\ \text{etc.}$$

In this way a table can be prepared giving deflections to be made to any point (every 30 feet), with transit located at any point. These tables are conveniently made out by Mr. Armstrong, for 30-foot chords = 1 rail length; but different foundation series and different tables may be made out, or special calculations made by equations (12) to (20) for a transition curve of any rapidity of sharpening, but of the same nature and handled in the same way. This is often necessary where there is not room between the *BC* of one curve and *EC* of the previous one to permit of the introduction of transitions which sharpen so slowly as 30 feet per degree.

In street railway work, for instance, transitions sharpening from 0° to 20°, or even 40°, etc., are needed, and must not occupy more than 20 or 30 feet in length. Special corrections must be applied in such a case, and even for steam railways Mr. Armstrong has worked out corrections in lengths to apply to the very approximate equations here given, but as the correction is zero until an 8° curve is reached, and only 1 foot in 300 for a 10° curve, it is hardly worth taking account of here. Any one desiring extreme accuracy for curves from 8° upward, are referred to J. S. Armstrong's pamphlet.

The three problems most frequently met with in practice are briefly as follows:

1. (See Fig. 16.) To keep tangents fixed and to move the circular curve inward, retaining the same degree of curvature. In this case, take an arbitrary offset or length of transition, and determine the other unknowns by foregoing equations. The distance from the apex of tangents to the *B T C* consists of three parts:

(*a*) Sub-tangent of circular curve = $R \times \tan\frac{\theta}{2}$ (R = radius).

(*b*) Correction of shift = $O \times \tan\frac{\theta}{2}$. (See Fig. 16).

(*c*) ½ length of transition = n.

The amount in (*b*) is usually very small, unless θ is large.

2. (See Fig. 17.) To keep the circular curve fixed, and move out the tangents either in direction or position, or both: If the tangents are moved outward and kept parallel to their original positions, proceed as in (1), except that the correction of shift (*b*) does not exist. If the tangents are not moved outward parallel to their original positions, but pivoted about some distant point, then calculate the angle pivoted, and continue the circular curve through an equal central angle. So that a tangent to the curve at the new *B C* or *E C* would be parallel to the pivoted tangent; then measure the amount of shift *O*, and by the ordinary equations calculate the unknowns; the amount of shift *O* could be calculated without any field work. No correction of shift is here necessary; this second case is most usually met with in revising location, and is very convenient often in the final slight movement of tangents or curves, by avoiding the running over again of the whole circular curves, often situated on a rough hillside or heavy bush, and yet enabling a tangent to be moved on to better ground.

3. (See Fig. 18). To sharpen a curve and introduce transitions, so that the track will not be altered in length; this problem is the one met with in re-running old track centres where transition curves have not been previously used.

The method of solution is to assume an external secant slightly less than the original one, by an amount = expected shift, *O*, + an arbitrary amount of five inches to ten inches, depending on the sharpness and total central angle of the circular curve; then calculate the transitions and complete position of a curve of assumed external secant and given total central angle, and, either by plotting or calculations, determine whether this new curve will cross the original one about at the ¼ points and give the same length of track, thereby minimizing the movement of the track. If in error, a second trial will give usually satisfactory results. This method will often be found to give transitions, which, unless the central angle is large, will occupy the whole central angle, leaving no circular curve at the centre. As this is not desirable, it is preferable in a case of this kind to use shorter and sharper transitions, so as to retain a considerable portion of circular curve at the centre.

While these are the three usual problems to solve, others may arise such as introducing a transition at a point of compound curvature which needs special solutions. For further details, the reader is referred to the literature already mentioned, and the engineer, young or old, who has not used transitions in the field, is advised to become familiar with some one of the forms given, and actually put it into practice, when its seeming tediousness and difficult nature will disappear.

He should recognize that, as he would be quite ready to spend a few hours extra now and then, during railway construction or maintenance, on trivial matters such as affect the general appearance of the road only, and are not really important, he should be far more willing to give much additional labor and attention to such a question as this, when the returns will be increased comfort to travellers, decreased wear on rolling stock, and greater ease in retaining good alignment at the ends of curves. Whenever transitions have been used, their beneficial effects have at once been recognized, and once established trackmen maintain them easily and instinctively. Some of the oldest and most conservative of the American roads are now engaged in introducing them on their permanent tracks.

STEAM TURBINES.

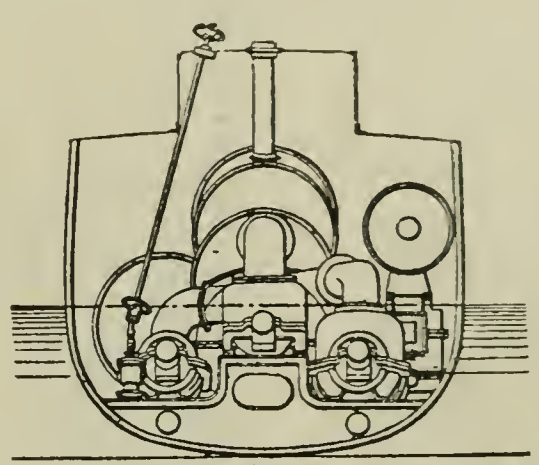
In the July issue of THE CANADIAN ENGINEER there appeared a description of the "Turbinia," the English torpedo-boat destroyer, whose great speed has attracted world-wide attention to the novel motor (the invention of the Hon. C. H. Parsons) which moves her propellers. We are now able to give drawings of the "Turbinia" and a fuller description of the turbine engines.

The Parsons' turbine consists essentially of a cylindrical case. Attached to the inner surface of the case are a number of rows of inwardly-projecting blades, which extend radially towards the axis of the engine. The function of these is to guide the steam. Through the axis of the engine there passes a shaft which is directly coupled to the screw-shaft. On the axial shaft is mounted a light drum, the external diameter of which is some inches less than the internal diameter of the case. When, therefore, the drum is placed inside the case and co-axial with it, there is left an annular space. This space is occupied by the blades, projecting inwards from the case before referred to, and by other rows of outwardly projecting blades attached to the outer surface of the light drum. The blades on the outer cylinder are called "guide blades," and the similar blades are known as "moving blades." When steam at pressure is admitted to the annular space it first comes in contact with a ring of the fixed guide blades, which are so formed as to direct the flow of steam on to the adjacent ring of moving blades at an angle to the surface of the latter, such as will cause the moving blades to rotate round the axis of the engine. As they are firmly attached to the drum, and as the latter is fixed to the shaft, motive power for a screw propeller or a dynamo is thus obtained. There are, of course, numerous alternate rings of guide blades and moving blades, there being perhaps eighty rows of both in an ordinary Parsons turbine. When the steam has been directed on one course by a ring of moving blades, it requires to have its line of motion altered so that it will strike the next ring of moving blades at the required angle. The guide blades are so shaped as to effect this purpose. In order to use steam economically it must be worked expansively, and this problem Hon. C. H. Parsons has solved in this way. As the steam does work, it necessarily increases in volume, and loses proportionately in pressure; to accommodate the increased volume additional blade area is given by gradually increasing the annular space and the size of the blades. Though its action in each individual turbine is approximately as if the fluid was inelastic, yet a small increment of volume takes place at each passage through the blades, and the expansion going on at something like geometric ratio at each of the numerous successive turbines, soon assumes large proportions. Ratios of expansion of fifty up to one hundred or even two hundred-fold are common in one single compound turbine of the condensing type—a notable feature in turbine practice being the high expansion ratios, and very large volumes can be economically dealt with without necessarily increasing the size and weight of the engine to any large extent.

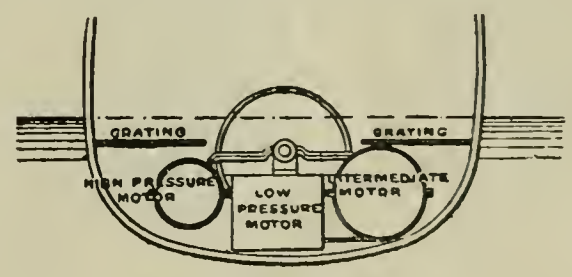
The high speed of revolutions diminished not only the weight of the engine in proportion to a given h.-p.; but also of shafting propellers and supports, as well as of the hull.

The inventor makes the following claims for the new motor: Greatly increased speed, owing to diminution of weight and smaller steam consumption; increased carrying power of vessel; increased economy in coal consumption; increased facilities for navigating shallow waters; increased stability of vessel; reduced weight of machinery; reduced cost of attendance on machinery; reduced size and weight of screw-propellers and shafting; absence of vibration; lowered centre of gravity of machinery, and reduced risk in time of war.

The "Turbinia" is 100 feet in length, 9 feet beam, 3 feet draught amidships, and 44½ tons displacement. She has three screw shafts, each directly driven by a compound steam turbine of the parallel flow type. The three turbines are in series, and the steam is expanded (at full power) from a pressure of 170 lbs. absolute, at which it reaches the motor to a pressure of 1 lb. absolute, at which it is condensed. The shafts are slightly inclined, and each carries three screws, making nine in all. The screws have a diameter of 18 inches, and when running at full speed they make 2,200 revolutions per minute. Steam is supplied from a water-tube boiler, and the draught is forced by a fan, mounted on a prolongation of the low-pressure motor shaft, the advantage of this arrangement being that the draught is increased as the demand for steam increases, and also that the power to drive the fan is obtained directly from the main engines. Up to the present the maximum mean speed attained has been 32¾ knots, as the mean of two consecutive runs on the measured mile. These runs



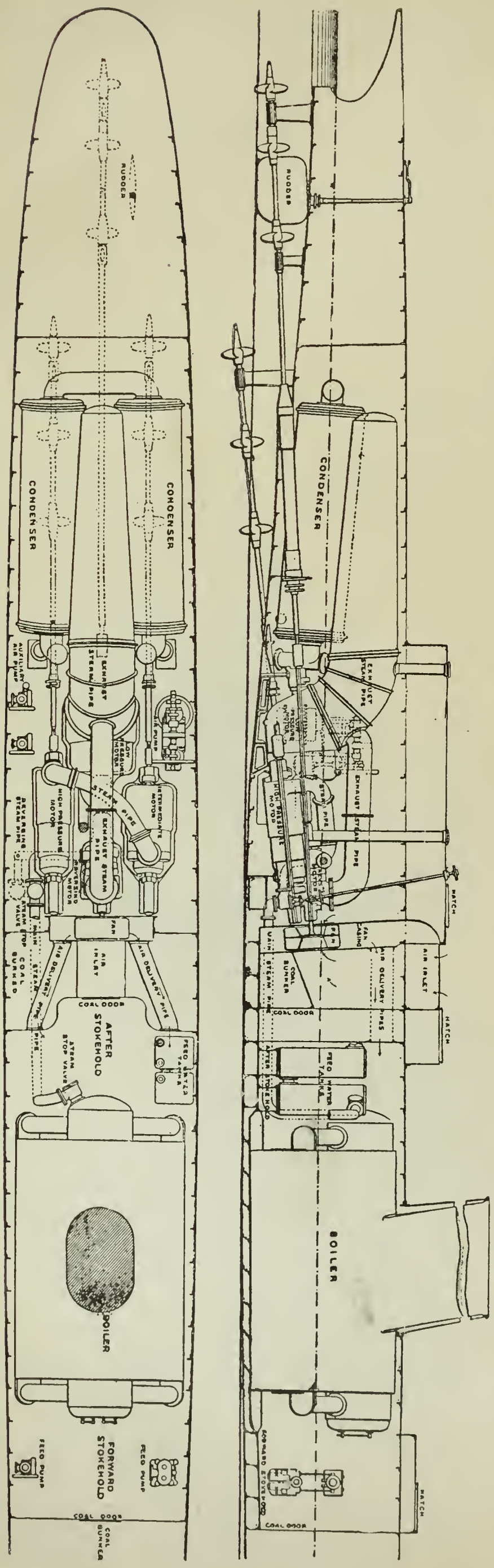
SECTION THRO' ENGINE ROOM LOOKING AFT.



SECTION THRO' MOTORS

were made after about four hours' steaming at other speeds, and the boat on the day of the trials had been fifteen days in the water. It is anticipated that on subsequent trials, after some alterations to the steam-pipe, still higher mean speeds will be obtained. As it stands, however, the I.H.P. realized is 2,100, and the consumption of feed-water per I H.P. hour 14½ lbs, and the speed the fastest of any vessel irrespective of size. The weight of the main engines is 3 tons 13 cwt. Total weight of machinery, including turbines and auxiliary engines, condenser and boiler, the propellers and shafts, the tanks and the water in boiler and hot well, 22 tons. Thus nearly 100 h.p. is developed per ton of machinery, and nearly 50 h.p. per ton of displacement of boat. The total weight of the "Turbinia's" engines is 3 tons 13 cwt., and they develop 2,100 indicated horse-power, as determined by Professor J. A. Ewing, F.R.S. Ordinary navy engines of the torpedo vessel class would weigh probably 15 to 20 tons.

"The advantages of a rotary-motor for the purpose of marine propulsion are manifest as regards a direct application of the force of the steam to the shaft to be driven, and a consequent saving of bulk, weight, friction and wear," says the *Marine Engineer*, London, in a recent article. 'When such a motor is shown to be economical in steam



construction, and that the power delivered by the motor at a high speed of rotation can be economically transformed into thrusting power by the screw propeller, and that the whole of the machinery is simple and easy to work, the position of the rotary-motor becomes well established as a rival of the reciprocating engine, provided there are no drawbacks to detract from the advantages which it manifestly possesses. Up to the present no such drawbacks have shown themselves, or seem likely to."

"The 'Turbinia,'" says *Engineering*, of London, "which, at the special request of the admiral in command of the fleet, made a run at full speed through the lines at the great naval review, is so novel a vessel that in spite of the remarkably successful results achieved by her, it would be difficult to say to what she will lead. Certainly it is a very long step forward to imagine steam turbines taking the place of the ordinary reciprocating engine in heavy vessels. But if the difficulty at present attendant on going astern can be overcome, it can hardly be doubted that for very high-speed craft the new system will find a conspicuous place in warship design, in spite of the multiple screws and the high rate of turning."

New principles, whose application seems likely to have such great influence in the future development of naval architecture, have not escaped the notice of the leading shipbuilders and owners of Canada. The Richelieu and Ontario Navigation Co., as noted in THE CANADIAN ENGINEER recently, has during the past couple of months examined the Turbinia model, with a view to its possible adoption for their new steamers.

INSTRUCTION IN PRACTICAL SCIENCE.

Discoveries made in the past ten years have materially changed the problems which civil engineers are required to solve and changed problems demand enlarged equipment for their solution. The department of the waterworks engineer has been most materially affected by recent discoveries. Formerly water supplies and sewage works were matters of construction and hydraulics. The water supply was obtained as pure as possible, and pains were taken to maintain that purity. The sewage was filthy and its condition was a hopeless matter—it was "disposed of" in "disposal" works or poured out to contaminate the water supplies of other places.

It is now established as a fact by scientific research that the dangerous elements of impure water and sewage are largely the same, are caused in fact by the presence of certain bacteria. These bacteria cannot continue to exist in the presence of certain other classes of bacteria, and the problem of water purification to-day is solved by the most advantageous bringing together of these various classes of bacteria.

It does not ordinarily lie within the sphere of the duties of a civil engineer to make cultures of bacilli, but if his practice is to include public water supplies and sewage works, he should possess sufficient knowledge of the general principles of biology and enough of bacteriology to know what should be done to determine the sanitary condition of the water he is dealing with and the effluent from his sewage disposal works. In order that a civil engineer shall be professionally qualified either to design some modern water supply and sewage-disposal works, or to maintain and operate them, it is absolutely essential that he should have suitable biological training in the school of civil engineering. How many of the civil engineers who have been instructed in our expensively equipped schools of science have ever heard of the bacteria of putrefaction, or who would know a microbe if they saw it with the aid of

the most powerful microscope. For example, do the students of the School of Practical Science, Toronto, an institution maintained by the Ontario Government, ever avail themselves of the lectures given during the college term by the faculty of the Biological Department of Toronto University, which is also maintained by the Ontario Government? We are unable to find any record their having done so.

While discussing this general subject we must refer to a paper by George C. Whipple, in the *Proceedings* for 1896 of the Society for the Promotion of Engineering Education, on "Biology for Civil Engineers." He points out the fact that the science of biology has intimately touched the profession of civil engineering in water supply and sewage practice, so that the educational training of a civil engineer can no longer be considered complete without a suitable grounding in bacteriology. In this he is undoubtedly correct. He pointedly observes that filters, which civil engineers must now design and operate as prominent features of both water and sewage treatment, are not mere strainers but immense colonies "of organisms whose one object in life is to convert the decomposable matter * * * into harmless nitrates." The bacteriological laboratories connected with the waterworks of Boston and of Brooklyn, to say nothing of others, show clearly what must of necessity be the trend of civil engineering education in relation to this matter, and the excellent work already done by civil engineers in the same line at Boston and other places demonstrates the correctness of the views we have expressed.

ANALYSIS OF NOVA SCOTIA COALS AND OTHER MINERALS.

BY E. GILPIN, JR., LL.D., F.R.S.C., INSPECTOR OF MINES, HALIFAX, N.S.

A set of analyses of coals from the three seams worked at Springhill by the Cumberland Railway and Coal Company were given me some months ago. They are made by J. T. Donald, Montreal, and were taken from the workings at a depth of from 800 to 1,000 feet. These analyses are interesting when compared with a set of analyses of the same seams made by me in the year 1881, and I believe not hitherto published, and with an analysis of the Black seam made by me in the year 1880, and published in the "Transactions of the North of England Institute of Mining Engineers," in a paper on "Canadian Coals," giving a full set of analyses of Nova Scotia coals, their ashes, etc.

East or No. 1 Slope—Black or Main Seam:

	Analyses made in 1897.	Analyses made in 1881.
Moisture	2.02	3.86
Volatile combustible matter	18.94	35.65 26.46
Fixed carbon	75.29	59.90 65.23
Ash	3.75	4.45
	100.00	
Sulphur	1.14	

West or No. 2 Slope—South Seam:

Moisture	1.41	1.399
Volatile combustible matter	27.93	34.808 31.225
Fixed carbon	67.47	58.003 61.586
Ash	3.19	5.790
	100.00	
Sulphur	.58	.808

North or No. 3 Slope—North Seam:

	Analyses made in 1897.	Analyses made in 1881.
Moisture	2.71	1.625
Volatile combustible matter	28.41	33.401 28.672
Fixed carbon	64.69	60.701 65.431
Ash	4.19	4 272
	100.00	
Sulphur	.79	.783

Analyst—J. T. DONALD, *Montreal.*

These analyses show the coals to be of excellent quality. The amounts of ash and sulphur are small, and that of the fixed carbon is large.

From a comparison of the later with the older analyses it will be seen that those of coal from the deeper portions of the seams show lessened amounts of volatile combustible matter, increased percentages of fixed carbon, and diminished amounts of sulphur and ash. Speaking in general terms, the coal would appear to have developed more into a steam fuel, the evaporative power being in a general way proportionate to the percentage of fixed carbon. This would give the coals as at present mined a high calorific power. From analyses by Mason and Matheson in a paper read before the Nova Scotia Mining Society, it would appear that the calorific powers of coals from the Sydney coal fields vary from 7238 to 7623; of Pictou coal (sample from Intercolonial mine), 6963, and of Springhill coal, 7898. As compared with United States coal, they should stand nearly in the rank of the best free burning coals of Pennsylvania, Virginia and Maryland. Those coals hold from 12 to 21 per cent. of volatile matter, and from 69 to 76 per cent. of fixed carbon. The average contents of the United States coals are from 29 to 35 per cent. of volatile matter, and from 53 to 67 per cent. of fixed carbon. These coals therefore from Springhill should rank for steam purposes next to the class which may be described as the best selected for use on the large ocean passenger vessels.

I have not at hand any proximate analyses of English coals to compare with these under consideration. However, taking the results obtained in the English Admiralty trials of steam coals, and comparing the percentage of fixed carbon found in the trials with the fixed carbon given in these analyses, it will be found that the English and Scotch coals run from 49 to 88 per cent., as compared with 68.2 per cent. in the Springhill coals. This would give the Springhill coal about the same relative position to the best Welsh coals as has already been assigned to it in comparison with the best American coals. The evaporative power of the Springhill coals would, from the analyses, stand higher than that of the English and Scotch coals, and rank next to that of the best Welsh steam coals. It may be remarked that the best American and Welsh coals would be classified as free burning, semi-anthracite, while the Springhill coals are bituminous and coking.

In the upper part of Georges River in Cape Breton county there is a large deposit of iron pyrites in rocks, which are, I think laid down as Laurentian by the Geological survey. The deposit has as yet been examined only superficially, but so far appears somewhat low in sulphur. The following analysis from the most promising exposure gives:—

Sulphur	25.00
Copper	1.10
Gold	Trace.
Silver	Trace.
Silica	52.00
Iron, etc.	25.00

For a number of years the presence of iron ore at Whycogomah in Cape Breton has been well known. The ores, which are magnetites and red hematites, are so very favorably situated, being close to the waters of the Bras d'Or Lake, that a good deal of work was done on them a number of years ago. A number of beds were opened and traced. They varied up to nine feet in thickness, and occurred in the limestone division of the Laurentian, as described by Mr. Fletcher in his numerous reports on the geology of Cape Breton, issued by the Survey. The analyses of the ores were contradictory in character, some being high in phosphorus, while others were very pure and ran high in iron. Last fall fresh discoveries were made in this district some distance from the old openings, of beds of magnetite, some upwards of 100 feet in width. Indications are not wanting that these ores extend over a large tract of country.

The following analysis will serve to show the quality of the ores:—

Silica	14.41
Alumina	7.33
Manganese oxide	.61
Lime	3.00
Sulphur	.22
Metallic iron	54.50
Phosphorus	Trace.
Magnesia	Trace.

Iron.	Phosphorus.	Sulphur.
55.70	None.	.68
59.60	.16	.23
63.20	.004	.31
54.30	.005	.38
53.20	.38	.25
50.74	.31	.024
53.12	.28	.026
52.85	.0058	.138

Silica	21.05
Ferric Oxide	53.54
Ferrous Oxide	21.24
Alumina	2.26
Manganese Oxide	.50
Lime	1.17
Magnesia	.36
Sulphur	.023
Phosphorus	Trace.
Metallic Iron	54.00

Metallic Iron	54.36
Phosphorus	.38

Silica	13.00
Metallic Iron	55.70
Sulphur	.68
Phosphorus	Trace.

These analyses show that there are ores in this vicinity valuable enough for shipment as regards quality, and the present owners consider that new explorations now being carried on will show that the ore is present in quantities sufficient to warrant working on a large scale. In this connection reference may be made to this division of the Cape Breton Laurentian in which these deposits occur. It may be distinguished as the limestone division, as it is distinguished mineralogically from the other, or felsite division, by the presence of numerous beds of limestone, in addition to the felsites, gneisses, granites, etc., common to both. These limestones furnish marble, as at West Bay and other localities, lime of excellent quality, and dolomites, suitable, as at New Campbellton, for furnace linings. Iron ores occur in them at numerous points both hematite and magnetite. Graphite is also found. In all probability, phosphates similar to those found in Quebec will be proved on search being made. Where these measures are cut by dykes, copper and lead ores carrying gold and silver occur, and may in some cases prove valuable. As yet, so far as my information goes, free gold has not been found in quartz in the limestone division. The gold of Middle River and Cheticamp appears to be associated with soft talcose and felsitic schists of the other division. This gold occurs at Middle River free in quartz and in the river gravel derived presumably both from the quartz and augmented by gold flakes from the schists. At the Cheticamp River, so far as can be judged from the work done, it would appear to have a similar source, and to be connected only with the felsite series. In the latter case part of the gold may be derived from mineralized zones adjoining the dykes cutting the various rocks. However, the explorations of the coming season will probably give us more exact information. It is interesting to note in connection with the occurrence of gold at Cheticamp that native silver occurs in the Mackenzie River a short distance north, and it is possible that explorations in that section may result in the discovery of important amounts of this metal and associated gold.

THE GREAT LAKES AS A SENSITIVE BAROMETER.*

BY F. NAPIER DENISON, METEOROLOGICAL SERVICE OF CANADA.

For many years fishermen and sailors upon our great lakes have noticed with interest and curiosity the rapid rise and fall of the water, most marked at the head of shallow lagoons or bays, and have considered it to be an inexplicable phenomenon. While in the vicinity of Lake Huron last summer the writer's attention was attracted by what appeared to be a regular ebb and flow at the mouths of rivers. At Kincardine, by means of a special float, a set of readings was taken, and a variation of level of over three inches observed, averaging nine minutes, that is eighteen minutes for a complete undulation. The weather at the time of observation was fine and excessively hot, but during the night the town was visited by a severe thunderstorm. During the same day at Goderich, a few miles distant, regular undulations of six inches amplitude were reported. From these and other observations, it appeared as if these undulations might be caused in some yet unknow nmanner by differences of atmospheric pressure upon the surface of the lake.

Upon returning to Toronto and discussing the matter with the Director of the Meteorological Service, he authorized me to proceed with the investigation as part of the regular work of the service, supplying the funds for the construction of such instruments as appeared necessary in a preliminary examination of lake undulations and atmospheric waves. An instrument was set up at the mouth of the Humber River, near Toronto, where ever since most interesting results have been obtained.

The following is a brief description of this instrument: It consists of a recording cylinder placed horizontally, which by means of clockwork completes one revolution every 24 hours. Resting upon this is a self-inking pen attached to an arm which slides freely upon a horizontal guide. This arm is connected by a line to the float, which is enclosed in a special shaft, so constructed as to admit the water only through several small holes; this prevents any sudden movement of the float being caused by local wave motion. As the float rises and falls, the pen correspondingly moves up and down upon the paper, which is revolving at the rate of one inch per hour. The ratio of movement between pen and float is as 1 to 4, so that a rise of one inch of water level corresponds to a movement of one-

* A paper read before the meeting of the British Association for the Advancement of Science, held in Toronto.

quarter of an inch upon the paper. One-quarter inch squared paper is used, the vertical lines marking fifteen minute intervals and the horizontal one-inch change in water level. To prevent the water freezing in the shaft during the winter months, oil was used, which had the effect of depressing the water level below the frost line.

In order to increase the value of these records, a similar instrument was set up at the Burlington Canal last September. Before bringing before you some interesting tracings taken from these instruments, permit me to summarize previous investigations in other countries.

This phenomenon had been noted by Duillier as early as 1730, upon the Swiss lakes, where it obtained the name of seiche, owing to the apparent "drying up" or recession of the water upon one side of the lake, when rising at the other. In 1779, De Saussure remarks that he believes local variations in the air pressure may be the cause. Vaucher supposed that the atmospheric pressure diminished over one part of the lake, while over another it remained constant or increased. If this change in pressure occurred suddenly, the water which had thereby been set in motion would not come to rest again until after a number of oscillations. Professor Forel agrees with this theory, which has also been accepted by Studer, Meyer and Favre. From 1854 to 1856 an important series of observations were made by six observers, placed at different points upon the shore of Lake Geneva, who, using a system of signals to warn each other of the approach of an oscillation, noted the variations of the barometer and of the lake level. As Professsor Forel, in his article, entirely disregards these barometric observations, they do not appear to have been published.

In 1876 Forel set up an automatic instrument to register these movements, and from records extending over four months he deduced the existence of three varieties of seiche, viz., transverse, duration 10 minutes; longitudinal, duration 70 minutes; intermediate, duration 25 minutes. Upon this instrument he also observed movements of what he terms "vibration" caused (1) by steamers. The interval between these is from 9 to 60 times greater than that between ordinary waves, and they preceded the approach of a vessel by about 25 minutes, or when it was 9½ kilometres distant, continuing for two or three hours afterwards. (2) By wind, having no regular time or rhythm, and varying in amplitude from nothing to 10 millimetres, and in duration from 45 seconds to three or four minutes. He remarks that "sometimes there are little or none with a strong wind."

Lord Kelvin gives a theoretic law for the duration of these seiches in any lake, viz.: the semi-period of an oscillation is equal to the time that a body, travelling at the rate which it would acquire in falling from a height equal to half the mean depth of the lake would take to traverse the length of the lake. Thus, the duration of a seiche is proportional to the square root of its mean depth. (Archives des Sciences Naturelles, Geneva, 1876). Applying this to Lake Ontario, and assuming the mean depth to be 300 feet, we obtain a theoretical duration for a longitudinal seiche, of over five hours. As will be shown later, the mean interval between the longest undulations, as taken from the Humber traces, is about 4 hours and 49 minutes. In 1880 Professor Forel, in a letter, states that the smaller and more rapid oscillations may be accounted for by dividing the lake surface into more than one nodal point. (Archives des Sciences Naturelles, Geneva, 1880). Mr. Crosman in his valuable charts of the great lakes refers to the existence of a "seiche" movement similar to that observed upon the Swiss lakes. He also states that when the lakes are undisturbed by the action of the wind, a regular series of small waves can be detected, which have a marked time interval of ten minutes. These pulsations appear on Lake Superior almost without cessation. Lastly, H. C. Russell, of Sydney, New South Wales, has studied these oscillations at the south end of Lake George by means of a self-recording gauge, and has obtained longitudinal seiche movements whose amplitude is about four inches, and time interval two hours and eleven minutes.

As the chief object of this paper is to demonstrate the direct action of the atmospheric waves upon the water, permit me to dwell for a moment upon the movements of the upper strata of our ocean of air, "at the bottom or on the shoals of which we live," as Humboldt so poetically says.

The late Professor Helmholtz, of Berlin, who has made a special study of atmospheric waves from theory and analogy with ocean waves, has clearly demonstrated the existence of huge waves or billows in the atmosphere like the waves in the ocean, which are due to friction between atmospheric strata of different densities, moving in different directions and with varying velocities. He also states these waves may be of all sizes from the minutest ripple to the gigantic billows which affect the barometer at the bottom of this ocean.* This theory is sustained by Professor Langley, of Washington,† and by Mr. Clayton, of the Blue Hill Observatory. The latter has also shown that the larger waves, as marked upon the barograph traces, have a maximum frequency with north-easterly winds, and a minimum frequency when the wind is from the south-west.‡ The chief point of origin of these waves appears to be at the lower boundary surface of the upper or poleward current which travels approximately from the south-west to the north-east in its spiral course around the globe. Its average summer velocity at this latitude is 60 miles per hour, which increases to 112 miles per hour during the winter months. When the lower stratum of air is travelling in an opposite direction to the superincumbent upper current, huge waves or billows are set up between these rapidly moving opposing currents, which are of different densities. Such conditions would exist during the approach of a cyclonic storm from the south-west. The influence of these huge waves extends to the earth's surface, where they have been recorded upon barograph traces. Other forms of wave movement in the lower air stratum (say cumuli level) may be caused by two subsidiary strata travelling at velocities and in directions differing from one another, as may often be observed during the approach of an important storm centre. These waves also extend to the earth's surface, and are recorded upon the barograph traces as short and rapid undulations.

Under certain conditions the existence of these atmospheric waves may also be observed in the cloud formations; for instance, during fine anti-cyclonic weather, one has frequently noticed great parallel bands of cirri clouds appear in the west, and rapidly extend eastward in advance of a severe storm. These represent the crests of the larger or primary billows mentioned by Helmholtz, and are caused by the lower denser stratum of air being forced up into a lighter and cooler level, where condensation takes place.

In order to pursue the study of the still smaller atmospheric undulations, which cannot be discerned upon the ordinary barograph, a simple form of self-recording air barometer was constructed and set up at the Observatory,

* From the Sitzungs-berichte of the Royal Prussian Academy of Sciences at Berlin, July 25th, 1889.

† Internal Work of the Wind, Smithsonian Contributions, 1893.

‡ Blue Hill Meteorological Observations, Vol. XL., Part III, Appendix E, 1893.

the scale value being 17 inches to 1 of mercury. To obtain a definite knowledge as to the manner in which the waters respond to the atmospheric pressure changes, the lake records and corresponding sensitive barograph traces have been tabulated in conjunction with the bi-daily synoptic weather charts, under the following headings:—

LAKE RECORD.

Date.	Time 8 a.m. 8 p.m.	Amplitude	Time Interval		Condition during last 12 hours.	
		In Inches.	7-8	8-9	Amplitude.	Mean Time Interval.

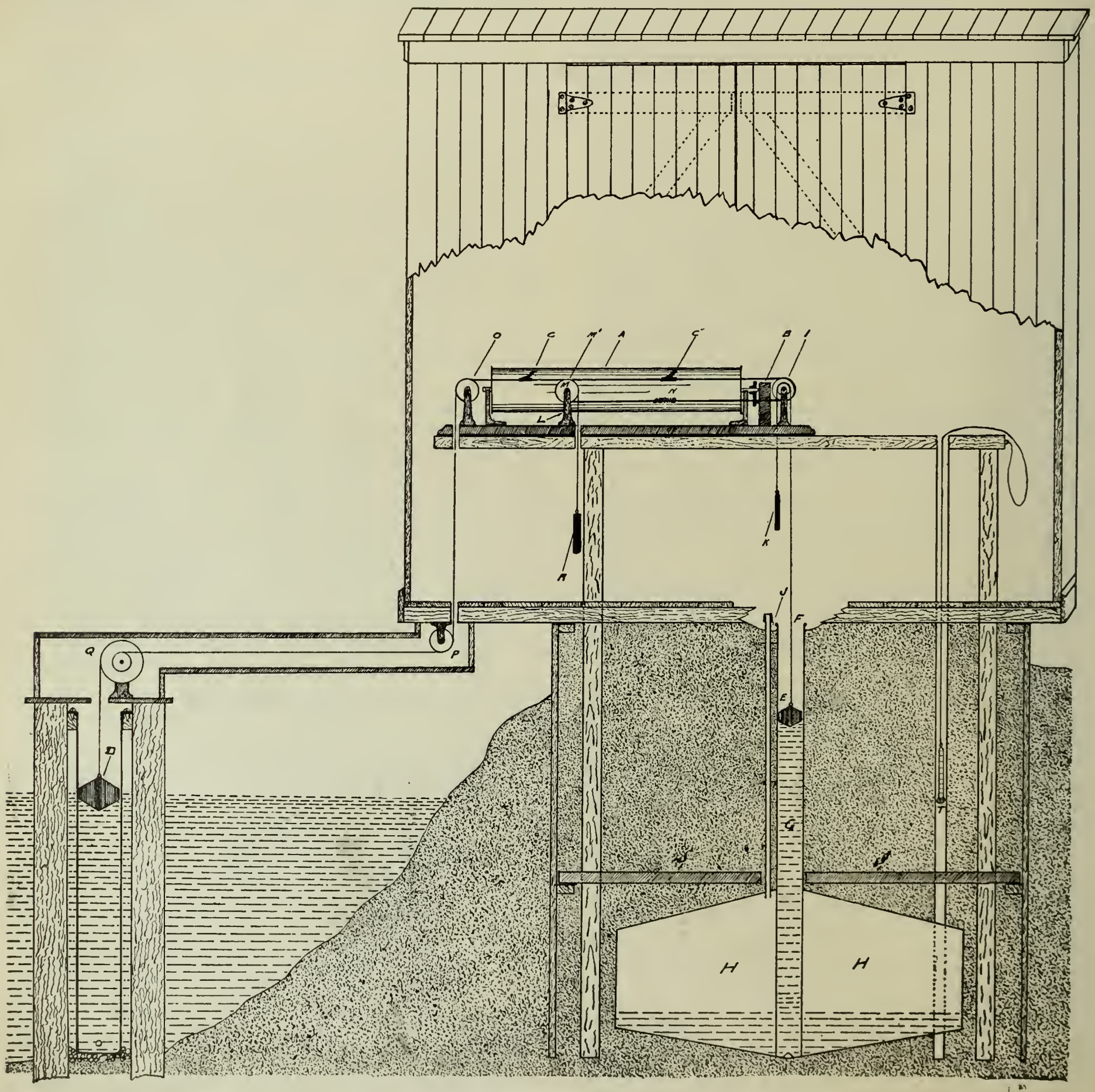
AIR BAROMETER.

		Amplitude	Time Interval		Condition during last 12 hours.	
		In Inches.	7-8	8-9	Amplitude.	Mean Time Interval.

Position of Lows and Highs, with barometer readings at their respective centres; barometer reading, weather wind and precipitation at Toronto, and remarks column

As the information obtained from these tabulations has clearly shown a marked correspondence between the air and lake movements, the writer has recently devised a simple instrument to record both undulations upon the same time sheet. This now supersedes the former instrument at the Humber.

The following is a brief description of this instrument as shown above, which is placed in a specially constructed house close to the water's edge: *A* is a cylinder, three feet long by twenty-four inches in circumference, which, by means of the clock *B*, completes one revolution every twenty-four hours. Upon this cylinder rest two self-inking pens *C* and *C'*, whose movements (though impossible to show in the above section) are quite independent of each other. *C* is actuated by the lake level float *D*, and *C'* by the float *E* in the air barometer *F*. This barometer consists of a vertical pipe *G*, four inches in diameter which passes



HYDRO-AEROGRAPH.

down through, and is attached to the bottom of a cylindrical air chamber *H*, four feet in diameter, constructed of a heavy gauge of steel. This chamber is hermetically sealed with the exception of two small holes at the bottom of the central pipe *G*. To complete this instrument, water is poured into the central pipe *G*, until the confined air in *H*, is compressed sufficiently to sustain a column of water,

upon which the float is placed. When the external atmospheric pressure increases upon the surface of the column of water in *G*, more water is forced into *H*, thereby reducing the height of the central column and increasing the compression of the confined air. When the external atmospheric pressure becomes less, the reverse action takes place. In order to prevent variations due to sudden temperature changes, the chamber *H* is buried five feet below the ground level, which in this case is also below the level of the water. The daily reading of the soil thermometer *T* gives a constant record of the temperature at this depth. To facilitate the sinking of the chamber *H* below the surface of the water the confined air was expelled by removing the cap from the small pipe *J*, and pouring water into the central pipe until *H* was filled. After filling in the sand to the top of the chamber *H*, double planking *S* was laid across from shoulder to shoulder of the curbing to prevent any variable strain on the top of H, due to changes of atmospheric pressure upon the earth's surface directly above. To put the barometer in working order the water was all pumped out, then after screwing the cap on the pipe *J*, sufficient water was again poured into the central pipe *G* until it had risen as shown by the dotted lines. To prevent evaporation the top of the column may be sealed by a suitable form of oil. Referring again to the recording portion of the instrumet *I* is a double grooved pulley placed between centres. Upon its smaller grooved circumference rests a line which has one end attached to the barometer float *E* and the other to a counterbalance weight at *K*. *L* is a standard supporting two grooved pulleys *M* and M^1 of similar diameter. Pulley M^1 which is obscured by *M* in the section is connected to the pulley *I* by a fine line kept taut by means of an adjustable spiral spring at *N*. To overcome friction the barograph pen C^1 is attached to a slender aluminum arm, which in turn is connected to a fine aluminum sleeve fitting tightly upon the line in such a manner as to permit a free vertical, but not horizontal, movement on the sleeve. The lake level recording pen *C* is attached in a similar manner to the line which starts from the smaller grooved circumference of the pulley *Q*, and passes over pulleys *P*, *O* and *M*, terminating in the counterbalance weight *R*. To prevent errors due to changes in the length of the line between float and pen, a fine plated steel wire was used from *Q* to *P*, and a special flexible material from this to the instrument. The recording sheet is ruled into one-quarter inch squares. Two feet upon the cylinder is allowed for the barometric range, and one foot for the lake level changes, and as the ratio of movement between pen and float remains the same as previously described (viz., 1 to 4), a range of twelve inches on the cylinder would correspond to a change of water level of forty-eight inches. Both pens are set in line in order that their times will exactly agree, also the barometric pen under increasing pressure is arranged to move up the paper in the same direction as the lake level would assume during a rise of the water. The object of this instrument is not so much to furnish a very accurate measurement of the atmospheric pressure changes, as are now obtained from the more expensive mercurial and aneroid barographs, as to magnify these movements to enable one to study the characteristic forms and extent of the ripples, waves or billows, which have lately been found to exist in our atmosphere during almost all conditions of weather ; also as a means of proving conclusively to what extent, and in what manner these atmospheric disturbances affect the waters of the lake. As this appears to be the first instrument of its kind the writer ventures to term it a hydro-aerograph.

(To be Continued)

THE GREAT NORTH.

A railway to the shores of James Bay or Hudson Bay is not only quite feasible, but it is urgently needed to develop the resources of our great North Land. For the past century and a half furs have been the great staple of trade in this region of Canada, but there are many sources of wealth about Hudson and James Bays, and some of these can only be drawn upon by means of a railway. Take the marine products alone. "The salmon," says an official report, "abound in the streams running into Hudson Strait so plentifully that a ship can be loaded with them in a few days. They are pronounced the finest in the world—much better in quality than those in the Pacific or those in the more southern waters of the Dominion." The same is said of the trout. The bay teems with other fish, such as cod, hake, pollock, whiting, etc. For many years American whalers have resorted here, and returns to the United States Fisheries Department show that the value of the "takes" of fifty whaling voyages there have aggregated $1,371,000, or $27,420 per voyage—a statement which ought to attract the attention of some of our Canadian sea fishing men who complain of bad seasons on the Atlantic. United States fishermen in the last ten years have taken out of Hudson Bay in fish oil and whale oil alone an average value of $150,000 a year ; while the Hudson Bay Company get over $50,000 a year from the blubber of the whale and porpoise. The narwhal, the walrus and the hair seal form very valuable sources of trade here. Of the porpoise alone, C. R. Tuttle, who accompanied the Dominion Government expedition in 1884, says : "I do not overstate the truth when I say that with proper facilities 4,000 or 5,000 of these oil-bearing animals could be taken at one place in a single season, which means blubber to the value of over $300,000." A railway to James Bay would pay, looking to the development of the fisheries alone, but these are only an element in the case. Countless millions of feathered game can be obtained here, such as wild geese, ptarmigan, curlew, and ducks. There are three or four varieties of wild geese and over a dozen species of duck, among which may be noted the eider duck, which produces the eider down so valuable in commerce. Leaving out of question the fur trade, which is still of immense value, it is to be noted that the country from Michipicoten north to James Bay is rich in minerals, though the real value of the minerals can scarcely be said to have been investigated. From the cursory trips of geologists and travellers we know there are deposits of gold, silver, molybdenum, galena, iron, mica, coal, graphite, asbestos, zinc, fire clay, salt, gypsum, copper and ornamental stones. Dr. Bell was struck with the fine specimens of pure copper pyrites, and of manganese iron ore. It would only be repeating the history of other regions, if the building of a railway would of itself lead to the opening up of new mineral beds not yet known to exist. Vast tracts of the country between the Ontario lakes and Hudson Bay are heavily timbered, and the spruce is of magnificent growth and excellent quality for pulp making. The pulp industry by itself would afford traffic in a few years for such a railway. Lastly, as to agriculture, it may not be generally known that the climate of the region in question is in the main as temperate as that of Manitoba, as the meteorological records at Moose Factory show, and "the gardens of Rupert's House, East Main and Fort George show that potatoes and all the ordinary vegetables thrive well." The Hudson Bay Co. maintain a stock farm at East Main, where cattle and sheep thrive well.

The subject of a railway to James Bay is just now engaging the attention of people both in Ontario and Quebec. The scheme for a road there from Toronto was outlined in our August number. In Quebec, Charles Baillairge has proposed a route starting at the present terminus of the Lake St. John Railway, and running up the valley of the Chamouchouan, thence across the height of land and down the Waswanipi and Nottaway rivers, reaching the Bay at Rupert's House. This route is endorsed by Henry O'Sullivan, Inspector of Surveys of the Province, who has been over the ground, and who more than confirms the statements we have made regarding the natural resources of the Hudson Bay region. Mr. O'Sullivan gives an interesting account of his explorations in the "Bulletin of Geographical Events of Quebec," just published. A committee of this society have drawn up a memorial to the Provincial Government of Quebec, urging the extension of the railway from Lake St. John to James Bay, without committing themselves to any route. They mention as an alternative route that *via* the Chamouchouan and Hannah rivers, the latter being west of the Nottaway. Information in the possession of the society goes to show that wide stretches of country along these routes possess a wonderfully rich soil, with a climate as favorable as that of the Lake St. John valley, which is now being steadily and successfully colonized. The distance from Roberval to Rupert House is only about 360 miles, and the highest point of land is only 900 feet above the altitude of Roberval. The mean grade from the height of land down to the Bay is only five feet in a mile, which makes the problem of construction very easy. The building of a railway to James Bay from Ontario or Quebec, or both, is well worthy the attention of capitalists, and the encouragement of Government.

The promoters of a railway from Toronto to Hudson Bay have surely made a blunder in tacking to it a suppositious navigation—beginning at the north end and proceeding, with an intervening railway stretch, from the west end of the Chesterfield Inlet, so called, but which is really the lower end of a long water course—to the Thlew-ee-cloh or Great Fish River. The assumption is of course that this river is or can be made navigable, at a cost which it would be possible to meet. The promoters must also assume that the waters beyond the Thlew-ee-cloh are so far navigable as to serve as a means of getting towards the Klondike. These assumptions are absolutely contrary to the fact. Some parts of the waters along this immense distance do provide the means of navigation for almost any kind of craft. Of the whole length of these water stretches the Mackenzie River is the best.

But what is the character of the Thlew-ee-cloh? Capt. Back, who, acting under instructions from the British Government, went along the whole course of the river from its source to the Arctic Ocean, in 1834, is the best, if not the only authority. His account of the river is very different from the imaginings of the gentlemen who, with a light heart and triumphant mien, talk of making it a link in the road between Toronto and the Klondike. "The Thlew-ee-cloh," Capt. Back, as the result of this special inspection, made under almost insurmountable difficulties, informs us, "after a violent and tortuous course of 530 geographical miles, running through an iron ribbed country, without a single tree on the whole of its banks, expanding into fine large lakes, with clear horizons most embarrassing to the navigator, and broken into falls, cascades and rapids to the number of no less than 83, pours its waters into the Polar Sea in lat. 67° 11′ 00″ N., longitude 94° 11′ 00″ W. Some of these obstructions occur below the point at which a railway from what, until the nomenclature is reformed, in accordance with recent discoveries, we must continue to call Chesterfield Inlet, would strike the Thlew-ee-cloh, but there are enough of them above to make the river unnavigable, by any expense which it would be rational to conceive possible or any delay of time which could reasonably be expected to be made by travellers on this route. This water route would take the pilgrim on his way to the Klondike some 200 miles too far south, at Great Slave Lake, and as he would have to go north again an equal stretch, the whole deviation would be 400 miles.

Between the Thlew-ee-cloh and Great Slave Lake the character of the navigation does not improve. Before Great Slave Lake could be entered, on the upward voyage, Parry's Falls, nearly twice the height of Niagara, would have to be overcome. Captain Back states this fall to be "between four and five hundred feet."

And how long would the waters on this route be open in each year? Captain Back started at the source of the Thlew-ee-cloh, on his downward voyage on the 28th June, and arrived, on his return, at the same place, Sept. 17th, having met much hindrance from ice most of the time. At what date in the summer does the ice in Chesterfield Inlet break up? What would be the length of the season of navigation on this route, if it were possible to establish any navigation that would serve as a suitable adjunct to railway travel?

Some one connected with the promotion of this amphibious railway project ought to give his days and nights to the study of the geognosy of the region to be traversed.

AN IMPROVEMENT IN GOLD MILLING PROCESSES.

The richest gold mines are not always the most profitably worked, as there is often more made from a mine in which the gold in the ore can only be economically recovered by the most exact processes. In Canada, so far, development has been largely confined to ores which are rich enough to yield profits without too expensive plants or too complicated processes. We must, however, seek on every side for improvements which will enable us to take profits from more of our low-grade ores and from our less advantageously situated leads.

Great economy in the water supply for gold milling is made possible by an improvement in milling processes described in a recent issue of the South African *Mining Journal*. Much difficulty has recently been experienced on the Rand through the scarcity and muddiness of mill water. Careful practice under working conditions and on several mines has finally established beyond dispute that one of the details of a slimes process—the admixture of a small percentage of slaked lime with the slimes-pulp—is a complete preventative of muddiness in mill water; and it may be taken for the future as one of the fundamental axioms in mill practice that no gold mill need suffer loss or inconvenience from scarcity of water if it has a supply sufficient to circulate through the battery, tailings plant, and slimes plant, and can make good a diminution of about 5 per cent. in that supply during the month's working.

In employing this process, about 5½ lbs. of finely-divided slaked lime are added to the slimes pulp for every ton of solid slimes contained, and within 2½ hours a large proportion of the water contained in the slimes-pulp is delivered back to the mortar-boxes clarified from all sediment, and having an appreciable alkaline reaction. As a rule the mill-pulp is separated, the sands being collected for cyaniding, and the slimes running away to the slimes-

dam, where it is sometimes weeks before the water becomes clarified, and where there is a loss by evaporation, leakage, etc., of never less than 25 or 30 per cent., and often more. Moreover, heavy pumping charges have to be incurred for the purpose of returning the still somewhat turbid water from the slimes-dam to the mill, as well as for the purpose of making good the serious loss by evaporation, etc.

For THE CANADIAN ENGINEER.

FIRE FIGHTING.

BY EXTINGUISHER.

Having some experience in the business of extinguishing fires, handling, drilling, and leading fire brigades in one of the British towns, and having for about a dozen years resided opposite one of the Toronto fire halls, I feel that I am in a position to make comparisons between the two systems. I have noticed that in nearly every large fire there is an unnecessary destruction of property, and damage to the extinguishing apparatus, and either through carelessness, recklessness, or questionable management, there is a large number of accidents and considerable loss of life, which offsets the good done by the brigade in staying the flames.

The system adopted in Toronto of compelling men to loaf their time away in a lazy fashion reduces their energy and efficiency, causing them to do their work, when it comes along, in a jerky, impulsive way, and when the brain is most needed it is often dull and inactive, on account of being underworked or undisciplined. Some five years since I was at a convention in London, Ont., when the mayor gave a show by calling the brigade to the square opposite the Boswell House. The roads are wide, but too narrow for one of the reels, which struck the curbstone and pitched off the men, one striking his head against a sharp corner of the hotel wall. This was called an accident, but I am sure it was one that could have been easily avoided by proper drill.

There appears to be small chance in Toronto of proving that a fire has been started purposely to defraud, because of the custom of our firemen of breaking open doors and windows and letting in the air in large volumes, which at once turns a smoky, smoldering mass of burning material into a fierce and destructive flame; and where a few gallons of water intelligently sprayed on the smouldering mass would have destroyed the fire without injuring other goods, the fact of letting in more air than is necessary to do the work, often causes the gutting of the building.

When a fire is started by illuminating gas a small quantity of air let into the building will cause a fierce flame throughout the whole premises. Many valuable buildings have been destroyed by allowing unlighted gas burners to be turned on at full near the bottom of air hoist or staircase well, and a small light burning near the top. If the building be a large one, it may take a few hours to get the well or hoist shaft sufficiently charged with gas to ignite, when a sheet of flame will start on every flat, and if a good volume of air be introduced to feed the flame, the whole building is sure to be destroyed, together with the evidence of the way the fire started.

Steam is the best extinguisher of fires when soda, salt water, or other chemicals cannot be used. A volume of water is of little value until split up into small particles and made into steam by the fire on to which it is discharged. In all cases the water should be sprayed on under strong pressure, and wherever practicable, forced under or into the centre of the burning materials, because by so doing, the water will more quickly be turned into the steam needed to extinguish the fire, and no useless water will be discharged to run off and damage the surrounding goods and premises.

The men selected for the best brigades in the old country are mechanics, who thoroughly understand the details and construction of buildings; who are used to work and climb to giddy heights; men with nerve sufficient to walk across a fifty foot beam suspended high up in the air with safety. They are trained to attack a fire at points where the water will have a telling effect, and to avoid discharging useless water, or damaging property or goods unnecessarily.

Factories where they use steam boilers can put out the most dangerous fire by steam in about two minutes without damaging any machinery or goods.

Extinguishing fires is a fine mechanical science, and a good team of practical men can put out fires without hurry, fuss, or losing their wits. They have no preventible accidents or loss of life, nor do they damage any of the surrounding goods by flooding. In Canada a good team cannot be got. We require a good show in the street, and we are prepared to let a small blaze spread and destroy a whole block if our stations are carpeted and surrounded with costly appliances. The *men* engaged are the last consideration. We want to see spirited horses tearing through the street. It is of little importance whether good judgment and care is used by the men when in action. We are sympathetic when a fireman is lamed or killed, and never blame the men who placed him in danger, though his manifest unfitness for such a calling was a sure guarantee that his life and limbs were in constant jeopardy.

The old story can with reference to firemen be re-told, that a good workman or mechanic is very valuable, and of service to his fellow man, but a person who is wrongly placed and ignorant of the points and details of his work, is worse than useless, for he not only destroys the valuable appliances that are entrusted to him to use, but he endangers the lives of others as well as his own.

ACETYLENE.

The formation of a company in Montreal for the manufacture of calcium carbide and the extension of the works of the Willson Carbide Co., of St. Catharines and Merritton, are among the evidences that acetylene gas—at present the chief product of the carbide—is steadily making its way as an illuminant in Canada. Of course prejudice remains to be overcome and it is evident that the board of underwriters who have framed the code of regulations for the use of acetylene in insured buildings have much to learn about the nature of this gas. These regulations, which are quoted elsewhere, are vexatious without any apparent reason, unless they are designed to prevent the use of acetylene altogether. It is carefully provided that there shall be no chance to heat a building, and as all generators have some form of water seal, how is a building to be kept from frost in a Canadian winter?

One of the most comprehensive and instructive articles on acetylene we have seen in a long time is that in the *Engineering Magazine*, of New York, for August. After tracing the first discoveries of acetylene the writer, Henry Harrison Suplee, gives an account of some of the experiments made in liquefying the gas for commercial use. This method of using acetylene for lighting would seem to be unsafe in ordinary hands, but when the gas is made direct from the carbide with water it is as safe as any other gas. "It is probably no more poisonous,"

says Mr. Suplee, "than ordinary illuminating gas, while its characteristic odor causes leaks to be readily detected. A number of experiments by Vicille and Berthelot have demonstrated that at atmospheric pressures, a decomposition originated at any point is not propagated through the mass of the gas. Neither a spark, an explosion of fulminate, or direct contact with flame causes any action beyond the immediate vicinity of the heat. When, however, the gas is subjected to a greater pressure than two atmospheres, it exhibits all the properties of an explosive mixture; hence, the danger is clearly marked, mixtures of acetylene are,or are not explosive, according to the proportions of the two components, the limits being between three of gas to one of air, up to twenty of gas to one of air, this being a somewhat wider range than is found with ordinary illuminating gas." When the gas is better understood, the liquefied form may be safely used, as it would have great advantages, considering that the liquid is only one four-hundredth of the volume of the gas—that is, a foot of the liquid would make 400 feet of the gas. One remarkable thing about liquid acetylene is its expansibility. A given volume at a temperature of 32° F. becomes 1.07 volumes at 62°, and 1.24 volumes at 96° which shows it to be the most expansible liquid known. Cylinders should not be filled full, as when brought from a low to a high temperature it would rupture a very strong vessel. "In no case, however, should explosions of the liquefied gas be confounded with supposed dangers of the gas at ordinary pressure, as the two are absolutely distinct." In concluding his interesting article, Mr. Suplee says: "While it may be too soon to draw definite conclusions upon all the points at issue, we may infer that acetylene as an illuminant has a positive value, which for many purposes is immediately available; that it can be produced and used without greater risk or danger than is involved in the use of ordinary illuminating gas; that in the compressed or liquefied form it should be handled by experts under well ascertained conditions; but that notable advances must be made in its economical production if it is to compete broadly with coal and water gas as an illuminating agent." The writer here refers to the cost of manufacturing the carbide, which he puts at 2.02 horse-power per pound of carbide.

BREAD VS. BOUQUETS.

Among the many attributes of perfection which are ascribed to the Ontario Government, that of Defender of the Beautiful has not hitherto been one. Culture its members have been known to possess, and a commendable interest has been shown in various cultures and cultivations from pigs to preachers, but their absolute devotion to the Beautiful has escaped public attention. The Parliament Buildings may be supposed to have had something to do with this; people who spent much time there could not but have their perceptions of the True and the Beautiful dulled, while it was generally conceded that any one who had anything to do with authorizing their erection must be entirely ignorant of the existence of these words, when spelled with capitals. But the public, as is generally the case, was wrong. The Ontario Government is prepared to sacrifice much to Beauty, and keeps the Niagara Peninsula a garden, a place of green grass and flower beds, and falling streams and trees; the resort of newly-married couples, and the people of Toronto on Saturday afternoons. The Government accepts $25,000 per year to keep in idleness a water-power whose development would be worth more to the Province than the timber limits about whose possible destruction we are at present so much agitated. We are well advised to look to our timber supply, of course; but if every stick of merchantable timber in Ontario were cut down, it could be replaced in time, though not without vast expenditure. But once permit the turning aside of natural and industrial forces, and who dare assume their return even with the most enormous expenditure? If the power of Niagara is once handed over to the citizens of the United States, it is lost to Canada forever.

In industry as in all living things there is no standing still; growth and death go on side by side and when growth is outrun by death the end comes. In the same way the industries of Ontario, and chiefly of Toronto and Hamilton, cannot go on in the next five years as they have in the past. Quebec has cheap labor to-day and to-morrow will have unlimited electrical power. We have only to name the great development companies over to remind ourselves of that: Chicoutimi, Montmorency, Shawenegan, Chambly, and Lachine. How can Ontario meet this competition except by power as cheap or cheaper than that in the neighboring province? If there were a tariff wall between the provinces, or if communication were slow and expensive, there might be some chance that the mill wheels of Ontario might still be turned by steam-power, but with the two best railways of the continent and the world's greatest waterway competing to reduce transportation charges there is no such chance. The only possible relief would be cheap coal, and Ontario has no coal, and southern Ontario has no power except what is derived from Niagara, and natural gas in a limited area of the West. Both of these are handed over to enrich aliens.

Some months ago in an article on this subject THE CANADIAN ENGINEER ventured the prediction that Niagara Falls would in future be more of an industrial force than an objective point for sightseers. We are pleased to notice that Lord Kelvin, during his recent visit to Niagara, at the time of the meeting of the British Association for the Advancement of Science, stated in an interview that he believed that all the waters of Lake Erie would ultimately find their way to Lake Ontario through electrical machinery. His Lordship said:

"I think we already see the beginning of what is destined to grow into a great industrial district around Niagara Falls, within ten or twenty miles of Niagara, both on the United States side and on the Canadian side. I do not prophesy anything, but I anticipate industry will advance on both sides of the border, and that the power of Niagara will be taken advantage of to any extent we may imagine. . . The originators of the work so far carried out and now in progress, hold concessions for the development of 450,000 horse-power from the Niagara River. I do not myself believe any such limit will bind the use of this great natural gift, and I look forward to the time when the whole water from Lake Erie will find its way to the lower level of Lake Ontario, through machinery doing more good for the world than that great benefit which we now possess in the contemplation of the splendid scene which we have presented before us at the present time by the waterfall of Niagara. I wish I could think it possible that I could live to see this grand development."

We hope the silence which the Ontario Government preserves with regard to this subject is only a cover for the discretion which they are about to display in the development of the natural resources of the country. It is remarkable that a body of men, who display such admirable judgment in the management of their private affairs, and whose administration of the public domain should be in most cases so excellent as to defy criticism,

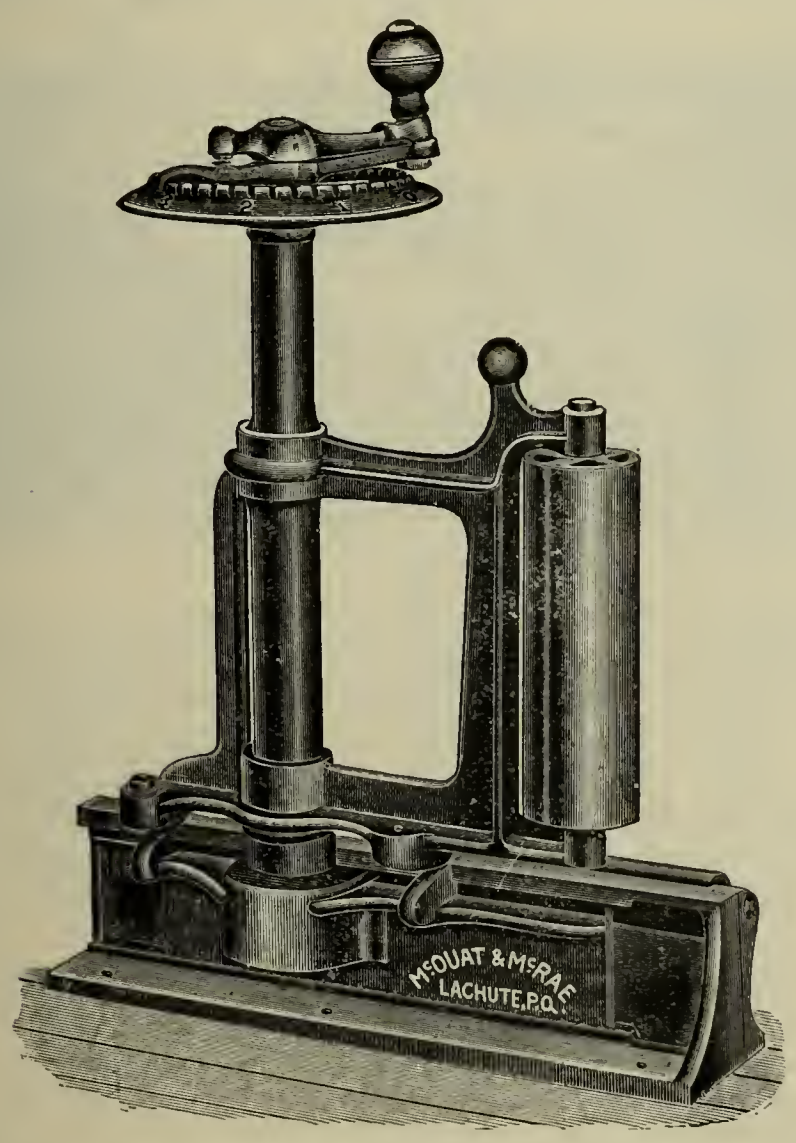
are unable apparently to make more out of one of our greatest assets than a few acres of flower garden.

Those who should be in a position to know state that the United States company has found means to arrest the proposed power development by a canal at Chippawa, and that nothing will come of the occasional activity of power company promoters on the Canadian side, at least nothing tending to the enrichment of Canadians generally.

What would be the verdict of the people upon a government which enacted a law forbidding the use of the steam engine and compelling manufacturers to resort to manual labor? What is the difference between forbidding the free use of steam in the past and forbidding the free use of electricity in southern Ontario for the next hundred years?

TIMBER GAUGE.

The Climax timber gauge, invented and placed on the market by McOuat & McRae, Lachute, Que., has been a pronounced success and has made its way steadily among Canadian lumber manufacturers. The makers prove a number of advantages for this device, which is illustrated herewith:—



The roller arm swings over the bed, and is so arranged that if the log strikes it, through accident or carelessness, it is merely knocked out of place and can be replaced instantly, without injury. This alone is of great importance to the purchaser. The standard is not stationary, but moves back with the roller bracket. It is never nearer than 11 inches to the saw, and will move back 22 inches clear of the saw. It can be moved out still further without loosening a bolt. It can be changed in half a minute from a right hand machine to a left, by changing a small stopper from one side of the standard to the other. The dial plate is divided accurately into inches and quarter inches, with distinct figures cast on, and notches cut deeply to hold index hand, so that there is no possibility of slipping or shaking out of position. The roller can be changed for different sizes of lumber, by simply pressing down on the crank, and turning the required notch and letting it go, no pin being required. To cut lumber heavier or lighter than the exact size, it is not necessary to move the machine on the saw frame, as the index hand is provided with an adjustment for that purpose. In designing it the makers took care that no place was left where sawdust could lodge and clog the machine, and they guarantee it cannot clog. If after ten days trial it is not found satisfactory, the purchaser may return it at the expense of the manufacturers.

FILTERED VS. UNFILTERED WATER.*

Through the researches of scientists it is to-day practicable to make hard water soft on a commercial scale; it is practicable to remove the matters giving rise to discoloration and disagreeable odors, and it is possible to remove almost to complete exclusion those minute forms of life which are supposed to be the source of many diseases, and which are carried and disseminated by water. In some cases natural influences effect a purification of water in certain directions; for instance, certain forms of low vegetable life in waters are destroyed by darkness; † certain other forms of microscopic life are destroyed by sunlight; ‡ certain impurities, like iron, can be removed by allowing the water to flow over a steep bed, or rapids, where it will become aerated. And a knowledge of these facts and many others, enables us to take any water that may be considered fit for a water supply to a city, and bring it to a very high standard of purity.

That pure water has been the means of saving many cities from dreadful consequences has had frequent proof. A recent very interesting case is that of the cities of Hamburg and Altona in Germany. The epidemic of cholera which broke out in Hamburg in 1892 will be remembered for its extremely "explosive" character. The history of this case is so very interesting that it will bear narration. On the river Elbe, some miles from the sea, there are two cities, adjoining and forming in appearance one city. These are Altona, a Prussian city,

Boundary line indicated by a line of dashes.
Cases of cholera by solid circles.
Cases of cholera imported from Hamburg by open circles.
Water mains in Hamburg streets by black lines.

and Hamburg, a free German city. A stranger walking through these cities would not know, unless informed, whether he was in Hamburg or in Altona. They are each supplied with water from the River Elbe, but their waterworks are independent of each other. In 1892 Altona took its water from the Elbe several miles below where the Hamburg sewers emptied into it. Hamburg took its water from above the city. At this point of the river the tidal influence is still felt, and at times the sewage from Hamburg is carried on a flood tide up the river occasionally as far as

* Abstracted from Some of the Important Water Supplies of Europe Considered Mainly from a Sanitary Standpoint, a paper by James H. Fuertes, Mem. Am. Soc. C.E., reprinted from the *Journal* of the Association of Civil Engineers of Cornell University.

† "Some Observations on the Relation of Light to the Growth of Diatoms." Geo. C. Whipple in a paper at the Ann. Conv. of the N. England W. Wks. Association, June 10, 1896.

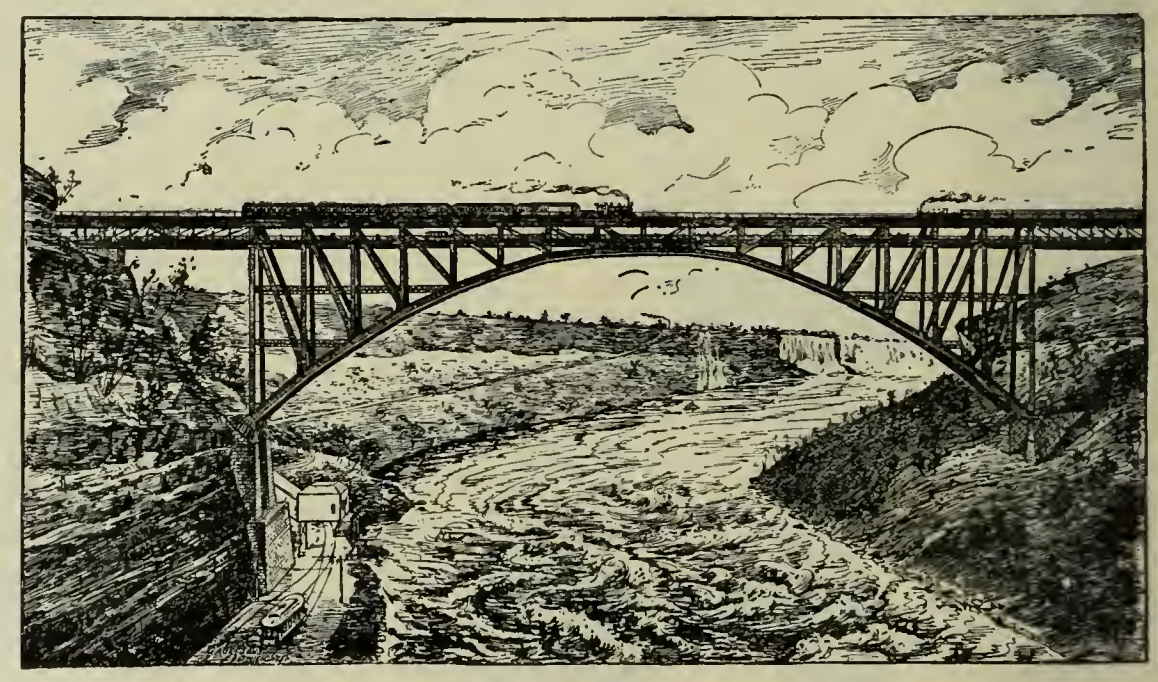
‡ "Water Supply," Professor Mason, 1896, p. 66.

the water-works. The Altona water was all filtered through large sand filters, carefully operated, while the Hamburg water was supplied to the people just as it was taken from the river. On August 16th, the epidemic of cholera in Hamburg began to spread alarm. In 12 days the epidemic had reached its height, and during the week of its extreme severity there were more than 6,000 cases of cholera in Hamburg. In about 12 days more the worst was over. By an inspection of the map of that part of the two cities near the boundary line between them, it will be seen how comparatively few cases appeared in Altona, and that it is possible, with an approach to accuracy, to define this municipal line by the location of the deaths from cholera. Many of the cases in Altona were caused by drinking the Hamburg water; many were developed there from other modes of infection, and many cases were of doubtful origin; but the fact shows graphically enough that the Altona filters saved that city from the fate that made Hamburg lose 8,000 lives in about a month, and spread terror and apprehension over the whole world.

The improvements at once undertaken and carried out in the water supply of Hamburg, have placed the city on an equality with its neighbor in the matter of pure water. The tests which are made almost continuously show the water to be comparatively constant in its composition and of a very high degree of purity.

THE NEW NIAGARA BRIDGE.

In our August number, we gave a description of the new great single-arch bridge of the G.T.R. over the Niagara, which replaces the well-known old suspension bridge. It only remains to say that the formal opening of the new structure took place last month beginning on the 23rd and lasting three days. Enormous crowds were present each day and night, and the fireworks display exceeded anything of the kind ever seen in Canada. A very elaborate programme of entertainment was provided for each afternoon on both sides of the river, and—what formed a very agreeable novelty in entertainments—all was free. The Grand Trunk Railway are to be congratulated on the handsome way in which they provided for the pleasure of the people, and upon their ability to provide for the transportation of such vast crowds of excursionists.



NEW NIAGARA BRIDGE.

BAILLAIRGE'S MARINE REVOLVING STEAM EXPRESS.

Editor THE CANADIAN ENGINEER.

SIR,—Marine Revolving Steam Express is the name of a vessel conceived by the undersigned, now some forty or more years ago. How the idea struck him or was originated in his mind, was from observing the rotation of a wheel under the impetus given to it by the feet of a squirrel. He imagined that such a wheel, if inclosed all around, and partly up the outer periphery of the ends or sides towards the centre or axis, and if then laid to run on any smooth surface or ice, would thus move with great velocity by the constant displacement of its centre of gravity by the motor inside of it. The same effect would, of course, obtain on any liquid surface as that of water, in which case it might be advantageous to put paddles around the vessel or cylinder to guard against any tendency to its slipping, and consequent backward or less speedy forward motion, though upon trial such paddles might prove to be of no necessity.

The diagrams on the accompanying plate are merely intended to be suggestive of the mode of steering such a vessel, by a rudder attached to it in a way to allow the vessel to revolve without carrying the steering apparatus with it in its revolution; as for instance, by tying it by a chain or belt around the vessel in a groove in the keel, said groove set with a series of friction wheels to ease the motion, and the rudder itself made heavy enough, without any tendency to sink, or while buoyant enough to float, too heavy for the vessel to lift out of the water; the steering gear being as shown, fixed to an outrigger extending each side through the open ends of the vessel, and supported by the engine, or as well as the passengers and freight on, or from a platform attached to the engine, or forming portion of the construction thereof. The smokestack of the engine, if driven by steam; or of the generator, if by electricity or compressed air, would of course have to be also taken out at the ends or at one of them, unless by dividing the outlet it were found, while balancing weight on each side, to accommodate itself better to the direction of the wind, shutting off one side while opening the other, or by both sides simultaneously if found advisable.

Now this idea or mere element could be multiplied or extended as required, so that the vessel which as per design might be suited to a mere lake or river with no wind blowing of sufficient force to overturn it, or as a mere water bicycle, could be adapted to rough water, to hold more passengers and freight by extending the vessel or cylindrical hull in length, while the diameter remained the same, or extending both in any required ratio. The hull or cylinder, for instance, might be of length to accommodate two or more motors climbing up its side together, when the two or three or more might be joined by one passenger and freight-carrying platform pivoted in a manner to remain in a horizontal position, as has been proposed for the dining room or saloon of an ocean vessel, in a way not to rock or pitch with the vessel. Again, the outriggers protruding from the ends of the vessel might be so braced from the non-revolving platform as to give them strength enough to suspend therefrom, as a car from a balloon, a circular or other water-tight receptacle, boat or vessel for outside passengers wherefrom to enjoy the view and air and such that, with any rolling of the hull or cylinder, the buoyancy of the outrigged boats, hanging as if from davits, would on striking the water help to right it and return it to its normal position. The diagrams show no other light penetrating openings than the open ends of the vessel, which in rough weather it might be necessary to curtail or partly enclose; but it is of course evident that any number of windows or lights might be introduced all around the hull or cylindrical surface, precisely as in an ocean steamer, and of course it could also be easily lighted up at night, as the want of sufficient daylight could be supplemented by gas or electricity with equal facility.

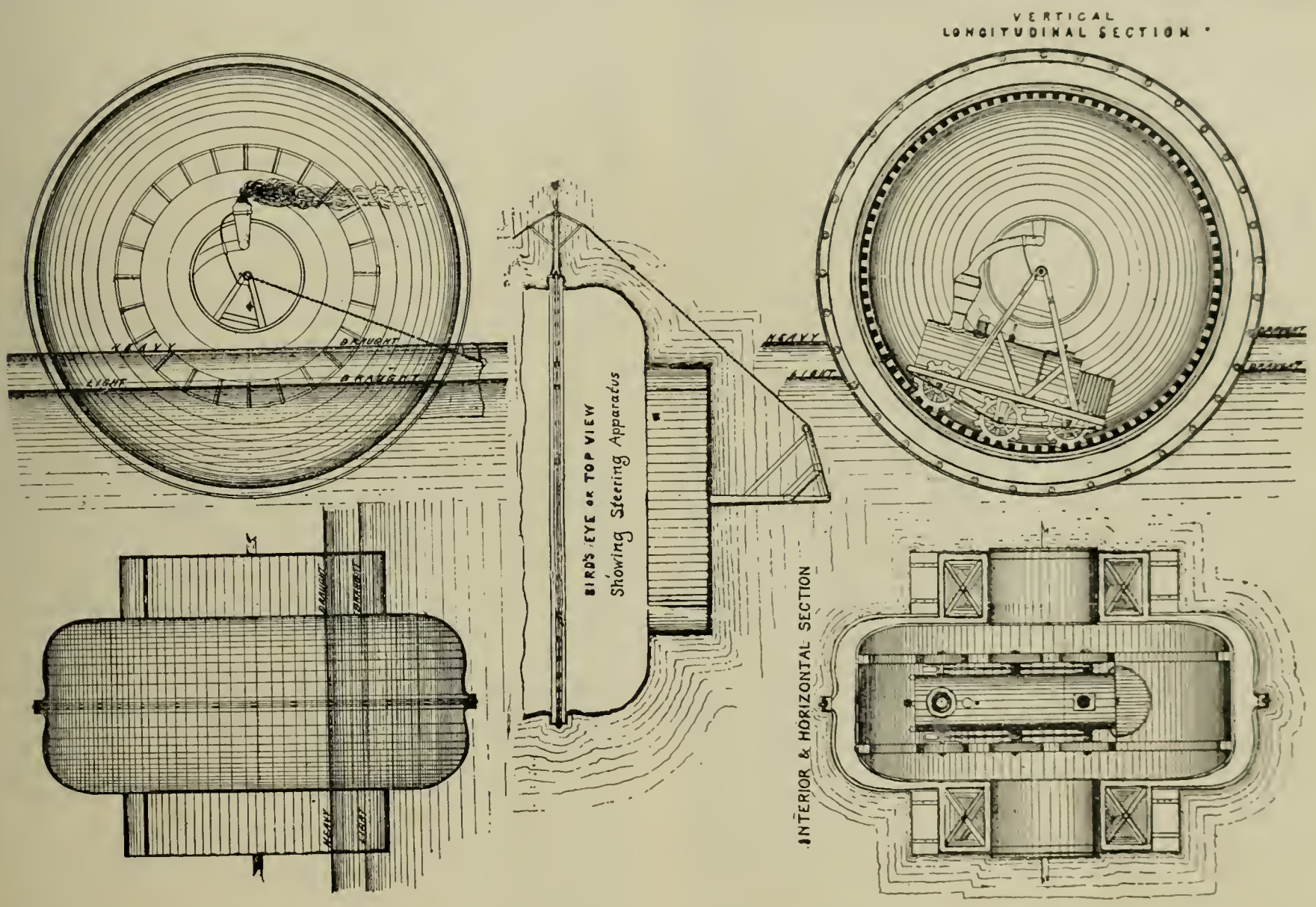
This plan has remained rolled up, out of sight and out of mind since it was made so many years ago, and at the time considered in advance of the age, though at the New York "World's Fair," held at the same epoch—sometime, I believe, before the war of secession (1853, I believe)—and at which it was on exhibition, though it, of course, attracted the less attention on account of its coming from such an end-of-the-world sort of place as Quebec, another invention purporting, as the papers then said, to be of the same description, had been exhibited by some minister of the gospel of a mechanical turn of mind, showing how two persons, who have never met may be similarly impressed, as with Adams' and Leveries "After Neptune." And now I see, by a paragraph in a recent issue of the Quebec *Daily Telegraph* that some other individual, one F. A. Knapp, of Prescott, Ont., has also been similarly taken hold of. This fact it is which has awakened me to the possibility of there being something in it after all, and that the time has come when the invention can be carried out, which I heartily leave to Mr. Knapp to do, without even hinting at the possibility or probability of his having ever heard of my priority of conception. Again, I say, two or more persons may at the same time or at intervals of years be imbued with the same ideas, as in the case of the first artesian well at Grenelle, in France, while many such had existed in China from time almost immemorial, and in the same manner as suspension bridges had been conceived as new in Europe, while centuries ago to be found in Asia.

Finally, if my idea of so many years ago was then before its time, as was also the "Great Eastern" when built by Brunel, and as the latter is now, or vessels almost as big as it, beginning to be utilized, so may my apparently impossible-of-realization conception of 1850 become a reality, and I wish Mr. Knapp all success in making it so.

In this age of rapid transit the world is ready for something sensational of the kind, an advance on Martin's boat on wheels, while in this instance the wheel itself is the boat, and the boat revolves. Every one knows the piece of mechanism called a horse-power, where a horse

without any forward motion of his own causes an endless chain or wheel to revolve under his feet. Now, let the horse be placed within this endless wheel or chain, and made to tread its under inner surface instead of its outer upper periphery, and a correct idea will be formed of this rotating vessel; since the horse-impelled wheel would evidently advance, if not debarred from doing so by being made a fixture.

The idea is also illustrative of how such a wheel may be looked upon in the light of a revolving tramway, or railway track, or track for any other vehicle, or for any man or animal on foot, and by which said man, or animal, or vehicle or engine might be said to lay its or his own track as he or it advances, or to carry his or its track with it; thus smoothing or levelling the way itself in a manner to avoid rough or bad roads, or to avoid sinking into deep snow, or mud, or mire, or as a man on a bicycle might be supposed to do by running forward on or up the inner periphery of a wheel of larger diameter encircling him and his bicycle, and rotating and moving forward with him, and in a manner so to say, to lay his own track as he went along over soft or boggy ground or snow, into which his bicycle might otherwise have a tendency to sink and retard his motion, while also increasing his labor of pushing through. The lights necessary in such a vessel to satisfy the rules of navigation and prevent collisions and accidents by night, would of course be established at the extremities of the non-rotating outriggers. To these salient extremities of the non-rotating axis or



shaft of the vessel, might also be attached circular signboards with the vessel's name painted thereon as on a medal, and arrangements could also easily be made by which a flagstaff might be erected at each end, and with halliards for working the colors as required.

Truly yours,

C. Baillairge.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In the following paragraphs we attempt to give our readers an outline of some of the papers read before the British Association for the Advancement of Science at its Toronto meeting, which are of greatest technical interest.

EARTHQUAKES.

Prof. John Milne, F.R.S., F.G.S., of Slode, Isle of Wight, delivered a lecture in the Massey Music Hall, Toronto, Aug. 23rd, on "Earthquakes," which was largely attended and very warmly received. Prof. Milne opened his address by referring to the fact that, because each student of engineering in Japan had to attend a course of twenty lectures on that particular branch of seismology, which has to deal with the subject of construction to resist the effects of earthquakes, it was evident that to satisfactorily epitomize all the knowledge we possess relating to seismology and volcanology within a period of 60 minutes, was a task of so much difficulty that, rather than speak of these subjects as a whole, he would practically confine himself to the answers of two very ordinary questions. First, what were the causes leading to displays of seismic and volcanic activity? And, secondly, what were the benefits we could expect to derive by studying the same?

In Japan, he told his audience that there was a belief, or, more correctly, a poetical conceit, that beneath the empire there lived a gigantic catfish, which, when it wagged its tail or moved its eyelids, shook the earth. Other subterranean monsters were the elephant of the Mussulman, the mole of India and the hog of the Celebes and Mongolia. After the shock, which, at the end of last year, rudely awakened the inhabitants of the Severn Valley, amongst other curious communications he received, there was one which at great length endeavored to prove that all the commotion was to be attributed to an earthquake-producing serpent which until recently had been buried beneath London, but which had escaped to the atmosphere and could from time to time be seen hovering above Trafalgar-square. Beneath Kamschatka the existence of a god called Tuil has been pictured, who drives with sleigh and dogs over subterranean snows, whilst beneath Scandinavia we have the imprisoned Loki, each of whom by his endeavors to escape or restlessness shakes our world. From subterranean mythology the lecturer passed on to the quasi-scientific theories of the middle ages, amongst which we find the unruly wind within the earth, which Shakespeare tells us "topples down steeples and moss-grown towers," the subterraneum tonitruum of Italy, the explosive gases and fatty vapors derived from a materia pinguis, chemical, electrical and other hypotheses.

The nineteenth century belief respecting earthquakes is that they are the result of rocky strata being bent—as in the process of mountain formation—beyond the limits of their elasticity. They are accelerations and announcements of orogenic and bradyseismical processes, which tell us that adjustments have taken place in the elastic or gravitational isostasy of the earth's crust. Wherever rocky masses are being folded, there we get earthquakes. If these foldings are near an ocean by capillary action water soaks inwards, a steam pressure is created, and the magma of molten rock and water from time to time finds an exit, and we get displays of volcanic activity. The reason that rock-folding exists is that the crust of our earth is not sufficiently strong to support itself above a nucleus which is gradually growing smaller by loss of heat. That which is happening on the surface of our earth is similar to that which would happen to an arch of brickwork of enormous span when the supporting centreing was withdrawn. Imagine such an arch supported on a centreing carried on piers across Lake Ontario, and then let the supports be gradually removed. The arch

would sink, crack, and buckle into ridges as it accommodated itself to the span between the piers. Each crack would represent a geological fault; when it was created the sudden snap would be an earthquake; whilst the hummucks and ridges would correspond to continental elevations and mountain ranges.

Turning to the useful aspect of seismology, Mr. Milne stated that, as the result of observation and experiment, many rules and formulæ had been arrived at respecting construction in earthquake countries, and it had been found that where these had been put into practice, the effect of seismic disturbances had been greatly mitigated. In Japan it was now clearly recognized that ordinary engineering practice as applied to embankments, piers for bridges, tall chimneys, the framing of ordinary dwellings, and other structures was to be avoided, and whenever, as, for example, after a disastrous earthquake, or a fire, reconstruction was required, new methods were adopted, the result of which is that the loss of life and property is being steadily reduced.

The application of seismometry to measure the irregular movements of locomotives has resulted in new forms of balancing the same.

The increased steadiness thus obtained is, among other things, accompanied by a marked saving in fuel. By the use of seismographs along the coast of Japan, submerged areas of seismic activity have been mapped through which it would be dangerous to lay a cable. Instruments which record the unfelt movements of the earth's crust sometimes tell us that cable interruption is due to earthquake action so far from land that it cannot be felt by those on shore. For want of information of this description in 1888, when three cables connecting Australia with Java were fractured simultaneously, in the former country naval and military reserves were called out, the supposition being that their sudden isolation indicated an operation of war. When it is remembered that this is by no means the only time a British colony has been suddenly cut off from communication with the rest of the world by the breaking of cables, such interruptions have shown the importance of being able to say whether this was brought about by natural or by artificial means cannot be overestimated. These same instruments, wherever they are established, give information of great seismic disturbances, even should they take place at the antipodes of the place of observation. Hence they enable us to correct, confirm, and even to disprove telegraphic information. From the enormous rate at which these earth messages pass through our earth, we see that our ideas respecting the effective rigidity of our planet must be modified. The daily tilting of horizontal pendulums has led to many experiments relating to the transpiration of plants and the subsurface condensation of moisture, which is of practical importance to the agriculturist. Possibly the long-continued tilting in one direction of these instruments may indicate that the ground or rock around that on which they are installed is gradually moving, seismic strain is increasing, and an earthquake may be expected. The seismograph has been employed to plot the roadbed of a railway, and in this way the condition of the whole line can be recorded and examined by the management at headquarters at any time.

Quite recently another line of investigation has been indicated which may possibly also lead to earthquake prediction. The effects of torsion and other stresses upon magnetized iron or nickel are well known, and it seems likely that the bending of rocks prior to the relief of stress may be accompanied by similar phenomena. In connection with this, Mr. Milne mentioned that prior to the two great earthquakes which last year devastated North Japan, at three magnetic observatories in that country the instruments showed unusual movements, commencing in both cases several days before the final collapse. The greatest magnetic perturbations took place some hours before the shocks, whilst afterwards, when seismic strain had been relieved, the magnetographs behaved in a normal manner.

The study of seismic sounds which are only heard on rocky strata, which do not travel far from their origin, which are not accompanied by perceptible movements, and which only occur from time to time, have been the means of laying many ghosts and re-establishing the reputation of country mansions. Severe shocks and volcanic outbursts have throughout the history of nations exerted an influence upon the nervous organization and the imagination, the effects of which may be seen in the character of a community, in literature, and its art. The study of earthquakes and volcanoes is of the greatest importance to the geologist, whilst it affords problems and facts of interest or value to the astronomer, the physicist, the mathematician, and to the student of all natural sciences; and in this way as an instrument increasing knowledge it becomes, directly or indirectly, a benefit to mankind.

Since his return to England, Prof. Milne has furnished a wonderful proof of the exactness of the records of the siesmograph. He writes: "While at the British Association meeting in Toronto I exhibited a seismogram which had been forwarded from my station on the Isle of Wight. This was the record of a large earthquake, the duration of which had been three hours. From the general character of the diagram, and because the preliminary tremors had a duration of 30 minutes, I suggested that the centre of the disturbance was in or near Japan, and, if so, originated there on Aug. 5, about 9.06 a.m. On Aug. 26, when I left Toronto, no news of such an earthquake had been received. I now find by mail advices, dated New York, Aug, 30, that in Japan there was an earthquake and tidal wave, accompanied by much loss of life, on Aug. 5 and 6. Capt Snow, of Yokohama, in a letter dated Aug. 5, says: 'While I am writing, a heavy, slow earthquake is going on. It is now 9 14 a.m.' The character of the motion felt by Snow indicates that Yokohama was a considerable distance, possibly 600 miles, from the place of origin of the disturbance. Therefore the time the earthquake took place was at least five minutes earlier than noted by Capt. Snow."

CANADA'S METALS.

Prof. W. C. Roberts-Austen, C.B., F.R.S., director of the Royal Mint, London, delivered a lecture in the Massey Music Hall, Toronto, August 20th, which was of the greatest interest to Canadians, as well as to the visitors from the old world. Prof. Roberts-Austen began by remarking upon the distinct relation borne to the welfare of the Empire by the metals of Canada. The point of a great part of his remarks was in the evolution of this idea. The strength of every country depended largely upon its metals. He hoped the Mother Country would soon learn to turn towards her eldest daughter for a supply of those metals necessary to the defence of the Empire. Since the British Association met in Montreal in 1844 interest in Canadian metals had been renewed. The lecturer accredited this result largely to the efforts of the Canadian Geological Survey. The principal mineral products of Canada were in gold, silver, copper, nickel, lead and iron, as well as certain of the rarer metals. He told of the wealth in gold of the British Columbia, Ontario and Nova Scotia districts. The attention of the whole world had been attracted in a sudden and startling manner lately to the new region—the Klondike. People were dazzled by stories of a country where wealth was to be obtained at the expense of privation, and ofttimes of death. Since 1884 the annual mineral output of the Dominion had doubled. "There was now a very creditable and comprehensive collection of ore and metals at Ottawa, as well as at London. I hope before long," he added, amid appreciative applause, "to take home to my countrymen some facts that will make Canada better known to them."

The slow development of these resources, he went on, was due to many causes. The first was the conservative attitude of the Hudson Bay Company, who controlled the mineral regions, and who for many years had devoted themselves to other pursuits than mining. But Sir Donald Smith of that company had been the first to bring down specimens of Lake of the Woods and Rainy Lake ore, and there was no doubt as to its value. As an instance how the order of things had changed, he told how, when he visited Rat Portage in 1884, it was a town with 870 souls; it had now grown to have a population of 4,000. Another reason for slow development was the former lack of railway communication, and a third of the false idea as to climate.

"We Englishmen," said he, "are not so assured as to the real facts regarding your beautiful climate as we might be." Sir Wilfred Laurier had aptly described it as hot summers, cold winters, and dry always. As to the Ontario deposits, enough was known of the territory north of Lake Superior to satisfy one that it was possessed of mineral wealth which made it the most valuable part of the province. Apart from Ontario was the great gold country of the west, British Columbia, where, since 1881, there had been an output of $12,000,000 of gold. Of the Yukon, where millions would be extricated in a few years, he urged that a route from the south was greatly desirable. It was said that there was scarcely a creek in the region that did not contain gold.

Diverting, he warned those who read of the riches of the Klondike, that they should not forget the qualities of iron and steel. Iron was a necessity to the Empire, for the best guarantee of peace was a readiness at all times to defend the Empire. The Canadians at the Jubilee must have been impressed with the display of 400,000 tons of steel afloat at Spithead. It was a fact that the navy required one-half of the iron output of the Mother Land. "Need I longer plead for the production in Canada of iron and steel for the protection of the Empire?" This point was followed by a reproduction on canvas of a map of the Dominion and illustrations of the mining operations going on in its various parts. The lecturer followed out his plea for the navy by experimental evidence as to the exceptional qualities for armament purposes of an alloy composed of Canadian steel and nickel. This was an argument in favor of the idea of utilizing the Canadian baser metals for purposes of Imperial defence.

Then came the sensational display of the evening. Branching out from the topic of Canadian metals into that of the properties of metals in general, the lecturer, with the aid of an electric furnace, operated

by his assistant, Mr. Stansfield, threw upon the canvas a representation of the melting of various metals.

The experiments, which were then made for the first time on the continent, he explained as he concluded, were intended to teach that metals were not inert, but were vibrating masses of sensitive matter, strangely life-like. The forces of evolution in the inorganic were not less majestic than those now universally accepted as pertaining to the organic world. Many might shrink from advanced ideas of this sort, but if any present feared the process, he assured them, with Sir Thomas Brown, that we could not but have a conciousness of Divinity within.

MAKING FLUORINE GAS.

Fluorine gas was made for the first time in America, before the members of the chemistry section, by Prof. Meslans, assistant to Prof. Moissan, Paris, whose researches with fluorine have been one of the features of the recent chemical progress of the world. Prof. Meslans came to Canada to make the demonstration, and succeeded admirably. His running talk which accompanied the experiment was in French, and was merely a description of the apparatus and method employed. Prof. Meslans' apparatus consisted of a bucket filled with snow and salt, in which was immersed a "U" shaped tube containing hydrofluoric acid. Two electric wires dipped down into the liquid, and small copper tubes carried away the liberated gases. These tubes first ran into a curious little copper vessel which was filled with solidified carbonic acid and alcohol to keep the temperature sufficiently low to prevent the destruction of the apparatus. When Prof. Meslans had arranged everything to his satisfaction the current was turned on and the gas began to form. Then a number of experiments were carried on, showing that the curious element attacked practically everything presented to it, bursting into flame the moment it touched charcoal, silicon, alcohol, benzine, sulphur, potassium, iodide, and many other substances. The demonstrations were greeted with many bursts of applause.

THE CONDENSATION OF STEAM ON METAL SURFACES.

Before the Mechanical Science Section a paper was read by H. L. Callendar, M A., F.R.S., and by J. T. Nicholson, B.Sc., on new apparatus for studying the rate of condensation of steam on a metal surface at different temperatures and pressures. As the result of some experiments by electrical methods on the measurement of the temperature changes of the walls and steam in the cylinder of a working steam engine, which were made at the McDonald Engineering Building of McGill University in the summer of 1895, the authors arrived at the conclusion that the well-known phenomena of cylinder condensation could be explained, and the amount of condensation in many cases predicted, from a knowledge of the indicator card, on the hypothesis that the rate of condensation of steam, though very great, was not infinite, but finite and measurable. An account of these experiments was communicated to the Institute of Civil Engineers in September, 1896, and will, it is hoped, be published in the course of the ensuing year. In the meantime the authors have endeavored to measure the rate of condensation of steam under different conditions by a new and entirely different method, with a view to verify the results of their previous work, and also to estimate the probable effect of wetness or superheating of the steam, and the influence, if any, of the film of water adhering to the walls of the cylinder.

THE PRESENT TENDENCIES OF ELECTRIC TRAMWAY TRACTION.

The Mechanical Science Section heard a paper on "The Present Tendencies of Electric Tramway Traction," by J. G. Waldridge. Among other points the author said, tramway work is, at the present time, and has been for some years past, characterized by an increasing use of mechanical traction systems. The reasons for this are obvious and self-evident. It is, however, worth while to look into the considerations that, so far as electric traction is concerned, have caused one system or another to grow into favor, noting also the inherent qualities or attributes of each, which must have an effect on future developments. The United Kingdom has practically 130 miles of electric tramway at work or under construction; of this length 103½ miles are operated on the trolley or overhead wire system, 15¾ miles by means of a third rail conductor. 6 miles by means of storage batteries, and only four miles on the underground conduit system. Objections to the overhead trolley wire system are almost entirely aesthetic, but at the same time have such great weight and force that every incentive is offered to the genius of invention to make improvements in other directions. The ordinary underground conduit with open slot is most expensive to instal and troublesome to maintain efficiently, it cannot be built for less than £10,000 or £12,000 per mile. Closed conduits with surface contacts usually operated by means of electro-magnetic switching devices in boxes under the street level are complicated, and it is to be feared are unreliable. The great weight of lead required on each car for accumulator traction means practically that the live paying load can never reach 25 per cent. of the gross weight of loaded car, whilst the combinations of trolley wire and battery, attempted on systems like those of Hanover and Dresden, are obviously ill-designed. The trolley seems to be the most desirable method.

NICOLA TESLA'S OSCILLATOR.

In the department of mathematical and physical science great interest was aroused by the reading of a paper prepared by Nicola Tesla on a new electrical oscillator, and the exhibition of the apparatus invented by him. The invention shown was a new machine for making Roentgen rays of extreme penetrating power It is designed to take the place of an ordinary induction coil, for the purpose of exciting a Crookes' tube, and was said by Prof Barker, of Philadelphia, who had seen it work in Tesla's laboratory, to furnish such a strong excitation, that with a fluoroscope he was enabled to look through Tesla himself, with the greatest ease. The device consisted of two large coils of wire mounted on a neat wooden base, which contained inside of it a new type of condenser made by Tesla himself One of these coils acted as a magnet to make and break the current, and at the same time helped to charge the condenser. This latter in turn threw its electric power into the second coil, which acted like an ordinary induction coil, but with extraordinary efficiency. According to the scientists present, this scheme was an entirely new mode of using condensers. After the reading of the paper by Prof. McClennan, the room was darkened and the current turned on. With a current from an ordinary incandescent lamp, sparks were produced six inches long. Then two fine wires tied to glass rods were stretched out parallel from the terminals. Immediately a band of glowing phosphorescent light was formed between the two, diversified with frequent brilliant sparks. During the discussion which followed several diverse theories were advanced to account for the operation of the new invention.

THE BARREN LANDS OF CANADA.

In the Geography Section, a paper read by J. B. Tyrrell, M.A., B.Sc., Ottawa, on The Barren Lands of Canada, was of especial moment. He stated that the barren lands, or more properly the northern plains and prairies of Canada, cover an area of about 350,000 square miles between the Mackenzie River and Hudson Bay, extending from the coast line of the Arctic Ocean down to the general northern limit of the forest. On the west coast of Hudson Bay they reach southward to north latitude 59 degrees, and thence their southern boundary extends in a northwesterly direction, roughly at right angles to the magnetic meridian, to within a short distance of the mouth of the Mackenzie River, crossing the Kazan at Ennadai Lake, the Telzoa River at Boyd Lake, and keeping some distance back from the shore of Great Slave Lake. In general character the country is a vast undulating, stony plain, thinly covered with short grass, while rounded rocky hills rise here and there through the stony clay. It can be divided into two fairly distinct portions, viz, the Coastal Plain, which rose from beneath the ocean in post-glacial times, and the Interior Upland, with a somewhat more pronounced topography, just as it was left at the close of the Glacial epoch. The whole country slopes gently towards the north-east, and the three main streams which drain it have a more or less parallel course in that direction. These streams are the Back or Great Fish River, with a total length of 650 miles; the Telzoa, or Doobaunt River, with a length of 750 miles, and the Kazan River, with a length of about 490 miles. The author showed illustrations, drawn from photographs, exemplifying the general character of the country, its herds of reindeer, and its native inhabitants.

THE FUEL AND AIR SUPPLY OF THE EARTH.

Lord Kelvin read a paper before the Mathematical and Physical Section, on the "Fuel Supply and Air supply of the Earth." "All known fuel on the earth," began his lordship, "is the residue of ancient vegetation. One ton average fuel takes three tons oxygen to burn it; and therefore its vegetable origin, decomposing carbonic acid gas and water, by power of sunlight, give three tons oxygen to one atmosphere. Every square metre of earth's surface bears ten tons of air, of which two tons is oxygen. The whole surface is 124 thousand millions of acres, or 510,000,000,000,000 of square metres. Hence there is not more than 340,000,000,000,000 tons of fuel on the earth, and this is probably the exact amount; because probably all the oxygen in our atmosphere came from primeval vegetation. The surely available coal supply of England and Scotland was estimated by the Coal Supply Commission of 1831, which included Sir Roderick Murchison and Sir Andrew Ramsay among its members, as being 146 thousand million tons. This is approximately six-tenths of a ton per square metre of area of Great Britain To burn it all would take one and eight-tenths of a ton of oxygen per square metre, or within two-tenths of a ton of the whole oxygen of the atmosphere resting on Great Britain. The commission estimated 56 thousand million tons more of coal, as probably existing at present in lower and less easily accessible strata.

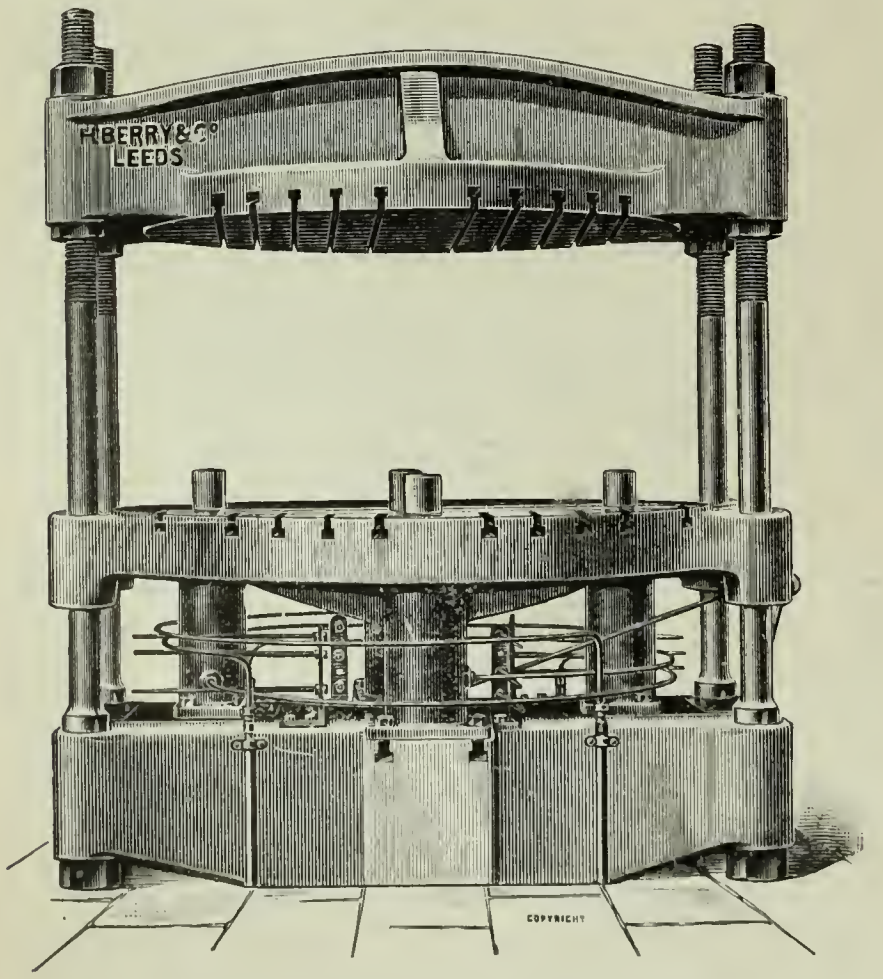
It may, therefore, be considered as almost quite certain that Great Britain could not burn all its own fuel with its own air, and, therefore, that the coal of Britain is considerably in excess of the fuel supply of the rest of the world, reckoned in equal areas, whether of land or sea."

In an Imperial Hydrographic Survey, read before the Mathematical and Physical section by Alexander Johnson, M.A., LL.D., professor of mathematics, McGill University, the author explained that in 1884, at the Montreal meeting of the Association, a paper was submitted to Section A by the present writer, in consequence of which a committee was appointed for the "promotion of tidal observations in Canada." The writer was made secretary, and subsequently chairman. This committee, supported by the Royal Society of Canada, and by those specially interested in navigation, succeeded, after many delays, in getting the Canadian Government, in 1890, to make a grant for tidal observations, which were to include not only the rise and fall of tide, but also the tidal currents. The grant was continued from that time until the present year, when it was reduced so that the survey of the currents could not be continued this summer, although an investigation of the utmost importance for the navigation of the St. Lawrence, more especially when the fast Atlantic line is going to be established. Possibly the entire grant is imperilled. It is believed that this reduction would probably not have taken place had there been in existence a fully organized hydrographic survey for Canada to advise the Government. The Royal Society of Canada had some time ago recommended the creation of such a department, and at its recent meeting in Halifax, appointed a deputation to present its views to the Government. The work of such a department can probably be most effectively carried out with the co-operation of the Admiralty.

The object of the communication was to seek the advice and aid of the British Association in inducing the Imperial and Canadian Governments to act together in making the necessary arrangements, which if found satisfactory, might possibly be extended to other colonies, and thus the basis of the Imperial Hydrographic Survey might be laid.

HYDRAULIC FLANGING AND FORGING PRESS.

The accompanying engraving illustrates a special type of hydraulic flanging press manufactured by the firm of Henry Berry & Co., makers of special hydraulic machinery, Croyden Works, Hunslet, Leeds, England. This machine is invaluable in large locomotive works where the plates to be flanged are of irregular form. The press is fitted with four auxiliary rams for holding the plate to be flanged against the top die, and these can be adjusted radially. In addition to this the central main



HYDRAULIC FLANGING AND FORGING PRESS.

flanging ram is so arranged as to form a cylinder to receive a further vice ram which will hold the plates in position when too small to be dealt with by the outside vice rams. The regular standard types of these presses are made to admit plates from 7 feet to 9 feet, the diameter of the ram of the smallest size being 14 inches and the largest 17 inches, with a stroke in the former case of 28 inches and in the latter of 30 inches. This firm are extensive makers of almost every kind of hydraulic machinery for every purpose, and their catalogue is quite a cyclopedia of special machinery, some of which is made by no other firm.

VIEW OF KING'S MOUNTAIN.

A very important work is being done by the Department of the Interior in mapping out the country which forms the boundary between Alaska and the Canadian Yukon. This work has been carried out

KING'S MOUNTAIN.

under W. F. King, chief astronomer, in honor of whom the mountain here shown has been called. It is a fine sample of Yukon scenery. The view is taken from near Pyramid Harbor, Chilcoot Inlet, looking south-westerly. The height of the peak is 6,500 feet.

GAS FROM GARBAGE.

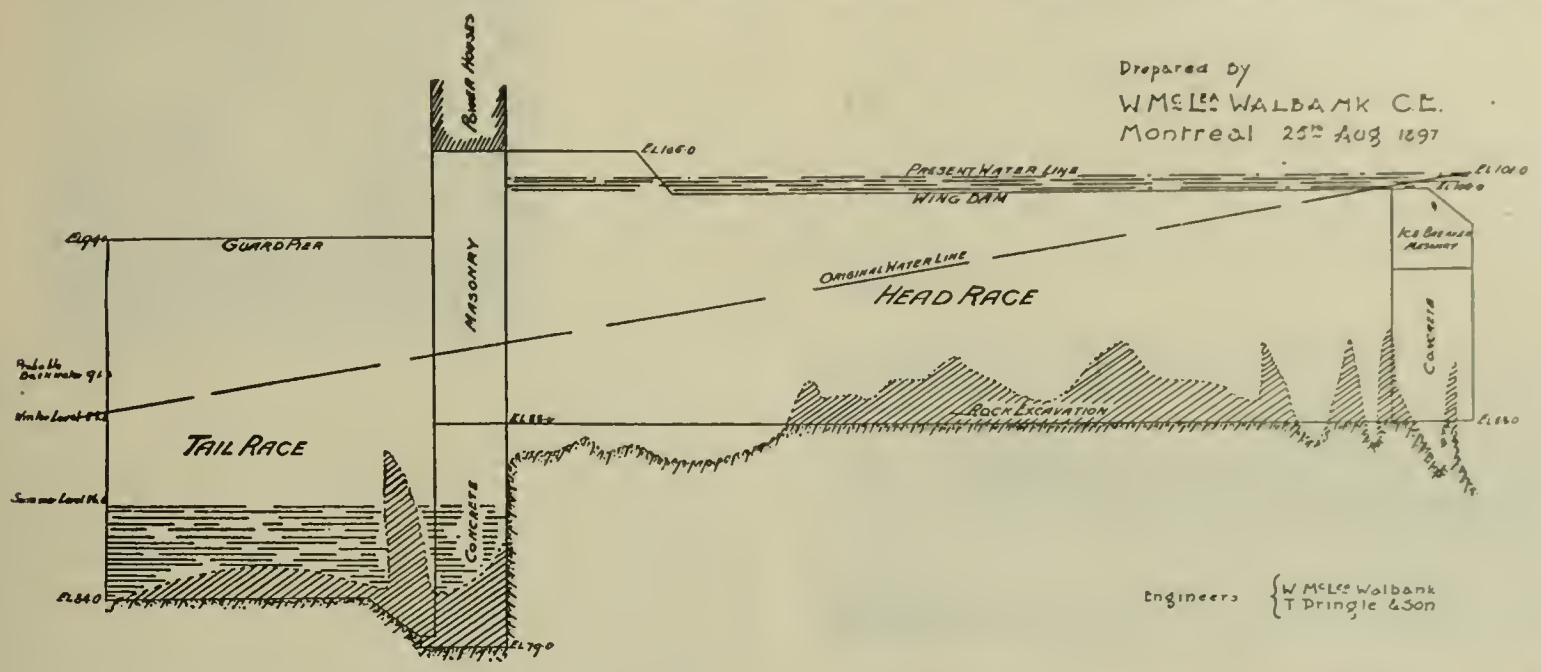
A representative of THE CANADIAN ENGINEER was called the other day to witness an interesting experiment in the production of illuminating gas from street garbage. For two or three years past, L. G. Harris, 55 Maitland street, Toronto, has been studying the problem of utilizing garbage, and as a result he has been able to show an experimental plant, in which a quality of gas about equal to that of Toronto can be generated at a cost of a few cents per thousand. The generator is a simple form of retort placed over a common box stove. Into this retort 10 or 12 lbs. of vegetable refuse, such as potato peelings, melon skins, etc., are thrown, after being mixed with two or three cups of gas oil and some chemicals—the latter being Mr. Harris' secret. A coke fire is started in the stove, and in a short time the contents are heated and the gas begins to develop in the retort. As it is evolved, it is passed through a cylinder filled with broken brick for drying it, and thence to a chamber filled with lime, by which it is purified. This is the whole process, as the gas then passes into the gas holder, whence it is distributed to the burners. The cost of the oil and chemicals for mixing with garbage to the extent of a ton, is estimated at from 50 cents to 75 cents, and a ton will produce 14,000 feet of gas. There is a residue left in the retorts in the form of a kind of coke, and it is calculated that enough of this coke will be produced in one charge to make fuel for the succeeding charge. If this calculation is borne out in actual experience, the cost of fuel will be entirely eliminated from the expense of operation. There is also a liquid residue, the nature and value of which has not been determined. As to the quality of the gas no analysis has yet been made, but Mr. Johnstone, inspector of gas for Toronto, and an official of the Consumers' Gas Co. regard it as being about 18 candle power, or two candle power above the standard; while the inventor claims that it is better than the gas of Toronto or any other city for cooking and heating purposes.

The cost of cremating the garbage in the two incinerators in Toronto is over $12,000 a year, and the cost of collecting and cremation together, apart from snow cleaning, amounts to about $50,000 a year. In many American cities of like population the cost of garbage disposal is considerably higher, the expense in Minneapolis, for instance, being $100,000 for removal alone, besides $20,000 paid to a contractor. The question of garbage disposal is a serious one for all cities, and if Mr. Harris can turn it into gas and coke as cheaply as he believes he can, a great advance will have been made in civic economy. At all events the mayor and medical health officer of Buffalo, along with a Buffalo capitalist, have been over to see his process, and so impressed are they with its utility that they seem likely to adopt it there, and have invited the authorities of Chicago and other cities of the States to investigate it. Peter Ryan and K. R. Arnett have acquired

the rights for Canada, and have a plant in daily operation at the corner of Church and Lombard streets, Toronto.

LACHINE RAPIDS POWER.

On the 2nd August water was let into the dam of the Lachine Rapids Hydraulic and Land Co., the second largest electric power works in the world; and on the 25th September the formal opening of the works took place in the presence of a large number of visitors. On previous occasions THE CANADIAN ENGINEER has given descriptions of the hydraulic features, the electrical features and the structural features



of these works. We give herewith a diagram indicating the physical features of the river bottom at the dam, and a reference to this in connection with our previous articles will show some of the problems that had to be solved in constructing the works. The observations of Messrs. Walbank and Pringle led them to believe that the difficulty of back water and ice in winter—which had been the *bete noir* of the engineers who had previously examined the Lachine Rapids—could be removed by blasting out the reef below the proposed site of the dam, and experience of last winter has shown that even the partial blasting away of this reef, which has already been accomplished, will do away with the trouble. There now only remains the question of the effect of frazil ice, but it is confidently believed that the large still-water basin above the works—walled off as it is by the boom and the natural dividing line of swift current at the head of the basin where the main body of water is deflected into the rapids at the rate of 10 to 20 feet per second—will avoid any serious trouble from this cause, as the still-water basin would be frozen over early, and frazil will not form under cover.

It may be of interest to recall the fact that the Lachine Rapids have been a source of power for over a century, one of the religious orders of Montreal owning a water power at the very site of the present works, where a grist mill, a flax mill, and a shop or foundry were running till the latter part of the present century. That this enormous power could be more extensively used evidently occurred to many, for in August, 1857, when the American Association for the Advancement of Science held its annual convention in Montreal a number of its members went down the rapids, and at the close of the meeting one of them congratulated the citizens on possessing such a city, and said there was "a power stored up here upon the shores, which within a hundred years will probably result in making this city the greatest city in America. This immense water-power being directed to the manufactures which might be established there, will make this one of the greatest cities of the globe." And yet this prediction was made before the possibilities of transforming water-power into electricity were realized. This prophecy probably moved local men to a consideration of the question, and in 1863 we find Thomas F Miller writing a pamphlet on the subject, and recommending the very thing which the engineers of the present work have carried out, that is the formation of "a sort of lake or pond as the supplying source in which an unvarying head would be secured, over which ice would, of course, form rapidly as far as still water extended upwards, where all the frazil coming from beyond (none could form in this pond) would, with the current which brings it down—in consequence of the resistance here presented—be deflected and swept off into the rapids and main channel of the river south of Ile au Heron." It remained for the present company to carry out the theories then advanced, and the result is the largest power development in Canada. The company has spent $1,500,000, and has recently had its capital increased to $1,750,000, practically all being Canadian money. As before stated there are now 48 wheels installed, but room is provided for 72. There will then be 12 generators, each

THE INTERIOR OF POWER HOUSE.

SUBWAY UNDER THE LACHINE CANAL.

connected to a series of six wheels, and making 175 revolutions per minute and generating current at 4,400 volts. The current is carried to the city on cables supported on steel lattice poles, the first of the kind used in this country. In order not to interfere with canal navigation the cables are led under the canal near Wellington street by a subway [shown in course of construction in the accompanying cut], which was built in the short space of 14 days, while the water was let out of the canal for cleaning. The cables are thence carried to the sub-station at the intersection of McCord and Seminary streets, where it is distributed for the city. The company has a controlling interest in the Citizens Light and Power Company, which has a 50 years' franchise for supplying St. Henri and St. Cunegonde suburbs, and shorter contracts for street lighting in Westmount and St. Louis de Mile End. It has also a controlling interest in the Standard Light and Power Co., which by a decision of the Privy Council, given on the very day the water was

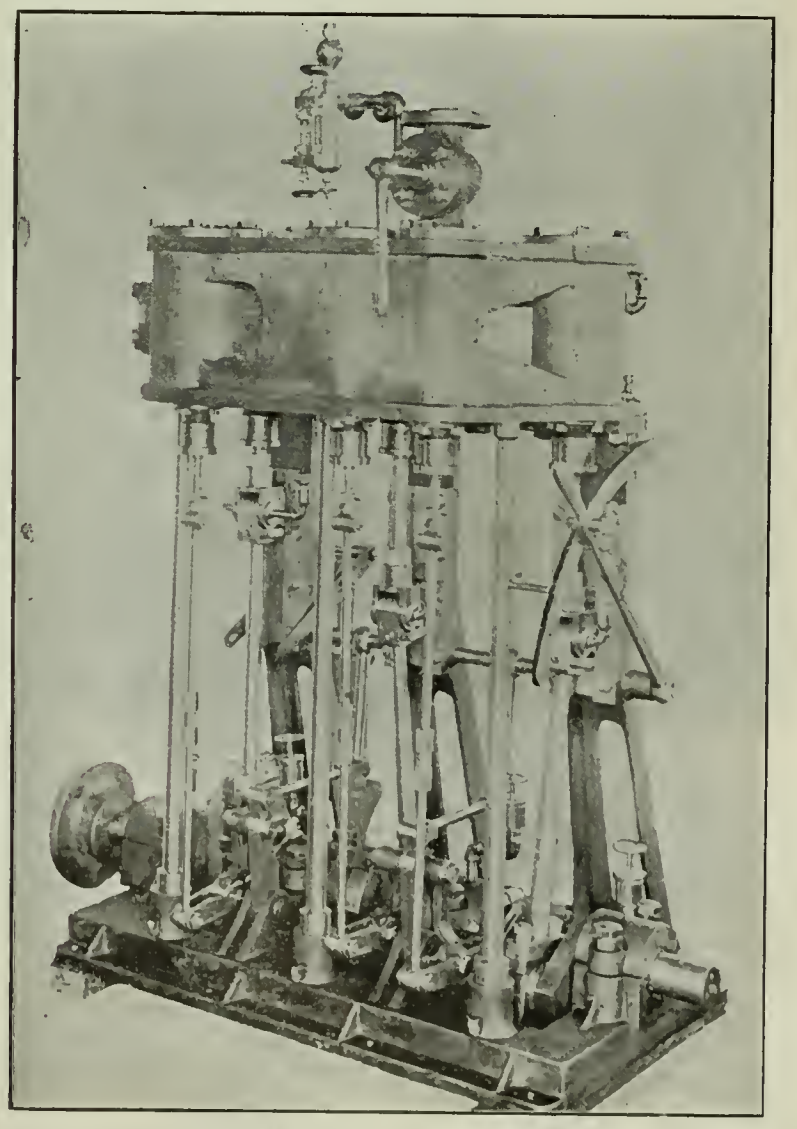
let into the dam, will have the power to construct electrical works in other cities, as well as in Montreal. The company owns a considerable amount of land near its Lachine works, and it is intended to lay out the foundations of a town and park, which will be connected by electric railway with Montreal. The officers of the company are: G. B. Burland, president; Alex. Fraser, vice-president; W. McLea Walbank, managing director, the other directors being R. Wilson Smith, S. Carsley, E. K. Greene, and Peter Lyall; Robert White, sec.-treas.; A. Cinq-Mars, auditor; T. Pringle & Son, mechanical engineers; R. S. Kelsch, operating superintendent; John Dodds, mech. superintendent; D. Barton, asst. electrical engineer; W. Kelsch, foreman of underground work, and E. Craig, superintendent of arc lighting.

A LAKE BUILT YACHT.

The cut shown herewith is from a photo of a cabin steam yacht built by Davis & Sons, of Kingston, Ont., for W. L. Standish, of Pittsburg, Pa., and now running on Lake Muskoka. She is 52 feet long, 10 feet beam, 4½ feet deep, and draws 40 inches of water. This handsome boat was contracted for on the 10th April last, to be completed

LAKE BOAT YACHT.

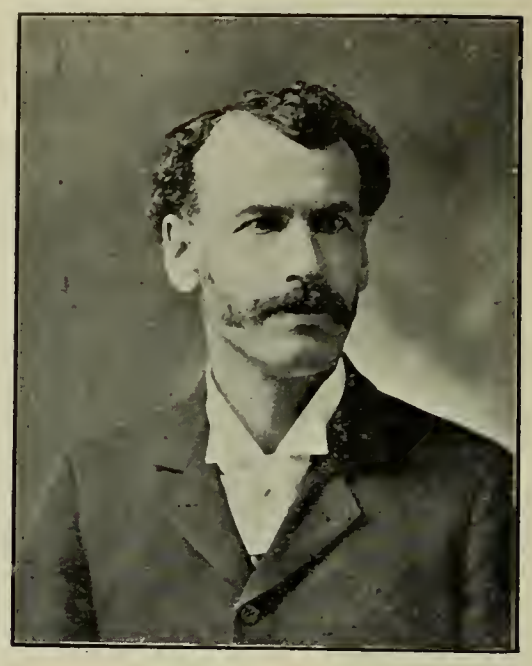
and loaded on cars by the 10th July. She made her trial run on the 8th July, with the owner and his wife, A. T. Lowe, engineer, and several gentlemen, and made a satisfactory record, and was shipped within the time called for in the contract. Her engines, which are shown in the cut herewith, are triple expansion, the size of cylinders being 5 inches, 8 inches and 13 inches, by 8-inch stroke, and capable of propelling the boat 13 miles an hour. These engines are fitted with the Bremme reversing gear, and turn a 38-inch brass wheel with 60-inch lead at a speed of 300 revolutions per minute when working under a pressure of 160 lbs. of steam. The boiler supplies 200 lbs. of steam



easily, and when the throttle is open the propeller will run up to 370 revolutions a minute. The engines and boiler were designed and made in Davis & Sons' own machine shops, and are considered a creditable piece of work.

WM. B. MACKENZIE,

MEM. CAN. SOC. C.E., MEM. AM. INST. C.E.



W. B. Mackenzie, who has recently been promoted to the position of chief engineer of the Intercolonial Railway, is a native of Pictou county, N.S., and is the eldest son of the late James Mackenzie, a farmer, land surveyor and road-maker, who did a large part of the land surveying, and highway location and construction in Eastern Canada. Mr. Mackenzie followed his father in these different occupations from the time he became old enough to hold the rear end of the chain and keep "tally" by cutting notches on a stick. After studying mathematics, including land surveying and navigation under Prof. Bayne in the Pictou Academy, he, in 1870, became leveler on the first preliminary survey of the Eastern Extension Railway, between New Glasgow and Cape Breton, and was in the same year appointed crown land surveyor for the county of Halifax. In 1872, when the Intercolonial was opened between Truro and Amherst, he was made office assistant in the chief engineer's office at Moncton, during which time he studied railroad engineering after office hours, including graphic statics, commenced under the tuition of Prof. Greene, of Michigan University. This, together with the bridge engineering course of the International Correspondence School, and other engineering subjects, has fully occupied his leisure hours to the present time. In 1879 he was appointed assistant engineer of the I.C.R. In this capacity he located and built the several branches of the Intercolonial, and designed the greater part of the bridge and bridge renewal work on the I.C.R. and P. E. Island railways, under the direction of the chief engineer, P. S. Archibald. He has travelled over and examined the tracks and bridges of the principal railroads in the United States, and has been quite successful in collecting information for the defence of several important I.C.R. law cases. In 1895 he spent several weeks at the principal U. S. creosoting works, and made a special study of the process at Norfolk, Va., where 1,900 piles were creosoted for the I.C.R. He has writen several essays on engineering subjects, such as: "Notes on Railway Location and Construction in Eastern Canada" (Trans. N.S. Institute of Science); "Cribwork Retaining Walls" (THE CANADIAN ENGINEER, Apr., '96); "Creosoting Timber" (pamphlet); "Painting Metal Bridges" (pamphlet): "The Tidal Marshes of the Bay of Fundy" (pamphlet). The third has been highly spoken of by competent judges, and the fourth is pronounced by the *Engineering Magazine* to be "one of the best essays on the subject that has recently appeared." He has been a member of the Nova Scotia Institute of Science and of the Canadian and American Societies of Civil Engineers for many years. His frequent inspections of I.C.R. connecting and other lines of railway has afforded him valuable experience, which, with an intimate knowledge of the Intercolonial Railway, seems to point him out as a person especially fitted for his present position.

The annual report of the Association of Ontario Land Surveyors for 1897 has just been issued, and makes a volume of 182 pages. The report contains the full text of the papers read at the last annual meeting in February, with reports of the discussions thereon, and the contents are, perhaps, more interesting than those of any previous issue. A portrait of Hon. S. P. Hurd, Surveyor General of Upper Canada in 1830, is given as a frontispiece, and a biographical sketch of him, with a picture of his birthplace in Bermuda, is given in the appendix. The obituary record contains the names of six members who have died during the past year, namely, W. R. Burke, Richard Coad, Michael Deane, J. R Peddar, Clifford E. Thomson and C. J. Wheelock. The secretary of the association is A. J. Van Nostrand, of Speight & Van Nostrand, Yonge street Arcade, Toronto, from whom all information can be obtained.

AN ENGLISH OPINION OF THE FAST ATLANTIC SERVICE.

The new contractors (says a correspondent of the *Marine Engineer*, London, England, when writing about the fast Atlantic service recently), Petersen, Tate & Company, have published their intentions in regard to the matter. It appears that the old terminal ports are not to be forsaken after all, in spite of the pleading of Sir Sandford Fleming in the pages of the *Queen's Quarterly*. The St. Lawrence and the Mersey are still to be the objectives. So far, good. But I am more than surprised to hear that the vessels which it is said are "to equal the 'Campania' in speed and comfort," are to be built of the turret type. This may be a most excellent type for cargo vessels—indeed it must be so, or such keen business men as those who direct the fortunes of Clan and Angier Lines would not be adopting it—but it does not look as though it were specially, or at all, adapted for passenger ships. It would be a thousand pities if a new departure were to be adopted in this regard which might imperil the popularity of the line with passengers, and so prejudice the link which we have so long desired to see forged to connect our little island with its great colonies in the west and south. But one cannot help having the greatest misgivings in regard to the whole business. Personally, I don't like the idea of the turret ships. I should rather hesitate in putting forward that opinion, where my judgment is opposed to that of practical men whom the British and Canadian Government unite to honor and confide in. But I am somewhat emboldened to differ when I see that along with the turret idea is one which all men may well make bold to call ridiculous. The fleet is to consist of four vessels of 10,000 tons each. Of these, two are to be at work, giving a fortnightly service, within two years. The others will follow and make the service weekly, twelve months later. In passing, it may be remarked that it will be interesting to see if these ships really approach the great Cunarders in speed. But a fifth vessel is to be provided. It is she which excites my distrust of the whole scheme and that apart from any other consideration. Lest I should appear to be stating the case in an unfair way I will quote from the *Shipping Gazette*, which certainly does not appear hostile to the contractors or their device. "Apart from the details in regard to the design of the steamers, the contractors have had to face a very tangible difficulty in combatting the fogs of the St. Lawrence. . . . Mr. Petersen set himself to solve this hitherto almost unsolvable problem, and hit upon the happy and thoroughly feasible plan of employing a fast little craft of the torpedo boat type, to act as pilot and danger signal to the ocean steamers. The little vessel is designed to travel down the river and meet the incoming steamer, and is to be fitted with a sound signalling apparatus and a powerful electric searchlight. . . . . She will meet the approaching steamer on her passage up-river, sounding her signals at intervals, and giving an extra signal in case of danger. Taking charge of the steamer she precedes her, and, acting as a pilot, enables the navigation of the waterway to be conducted at a comparatively high speed, but nevertheless with comparative safety." The paragraph I have briefly quoted is printed by my contemporary in large type and is from the pen of their Newcastle correspondent. It concludes with a statement of the "great appreciation" with which the Canadian Government has accepted this "excellent device." But I imagine the Canadian Government is composed of neither sailors nor pilots, whilst I also feel sure that the Newcastle correspondent of the *Shipping Gazette* who went to see the firm which is at the moment in such prominence was a most experienced journalist, and one who did not allow the light of his own knowledge to obscure the 'happy idea' upon which Mr. Petersen had hit. What does it all mean? I am sure Mr. Petersen is welcome to all the credit his labors may bring him, and I hope his 'happy device' may prove as valuable as he expects. If the torpedo boat can find the liner to guide her, she could also find her to put a pilot aboard of her. That is to say, the pioneer can have on board no guide, whom she might not be able to put aboard the guided. I suppose the big boats will draw 26 feet of water. A torpedo boat draws more like six feet. Her search light then will prove a mere will-o'-the-wisp, unless she maintains constant soundings based on the draught of the vessel she is piloting. Surely a liner with a big crew and lots of deck room is more suitable for all this sounding than a little craft. But let that pass. Let us even assume that the little vessel is instinct with knowledge that cannot be put aboard the big ship. What good will she be? Has Mr. Petersen ever heard of or seen a sea fog, either in the Gulf of St. Lawrence or in British waters? Does he not know from hearsay, at least, as some of us know from experience, that what sailors call a dense fog means an atmosphere so thick that the officer on the bridge cannot see the crow's nest, and that the most powerful light that ever was put into a lighthouse is obscured at a few yards' distance? The search light will be useless unless the torpedo boat runs the chance by her proximity to the liner's bows, either of being run down or of leading the liner into shallow water as she avoids a collision I do not say that the St. Lawrence is so bad as Mr. Petersen makes out in the matter of fogs, but I do say that when fog is encountered, either in the St. Lawrence or elsewhere, so dense that a leading boat of light draught is required to pilot a mail steamer, it is quite time for the captain to stop his engines and drop his pick."

BOILER SETTING.

Editor CANADIAN ENGINEER.

SIR,—I was very much pleased with your article in your August number on the heating power and value of the coal we engineers have to handle daily. You have given the calorific value of coal and constant heating power of carbon 14 652, and the constant heating power of hydrogen 62.100; these two together you call volatile matter, or hydro-carbons = 14.652 + 62.100 — 5,400 neutralizing effect of oxygen less heat formed by the formation of nitric acid. In the real value of coal, say anthracite or hard coal, we have the fixed carbon, which is contained now in the ashes we throw away, equal to 28.648. This is too much to throw away or lose, more than a quarter of a ton on a ton, and if what you say about the measurements by instruments is correct, we may safely say a great many men using coal do not get out more than one-half its value, by inattention and bad construction of furnaces and boilers. I have chosen anthracite, because I use more of it than of bituminous.

The question may be very naturally asked, how shall we get more heat out of our coal and ashes? Our attention must be turned to the construction of our boilers, furnaces and chimneys, and leave the instrumental measurements to decide afterwards. About thirty years ago, I got this subject before some of our manufacturers in this city; I then got a boiler 14 feet long by 48 inches diameter, with two large flues 11 inches diameter each, and above were 19 tubes 4 inches in diameter, with a division plate behind and a smoke box in front, with four strong cast brackets to carry the boiler over the fire; the brick bed was laid down; the front was what was called half front. There was a dead plate nine inches wide, with a recess for the ends of four feet bars, and a bearer at the back of the ash-pit. The bars were raised behind four inches; the brick work behind the bars sloped up to the end of the boiler to eight inches, and six inches short of the boiler. There was no bridge, for I saw it was not wanted. At first, when the fire and bars were put into the long flue of the old Coruish boiler, with bars fitted across the flue below the centre to give room above the bars; they also dipped the bars behind to give more room for the fire, and built up the back of the ash-pit so as to keep the ashes from getting beyond the reach of the fireman and also to prevent the air from going in farther than the fire bars. On the top of this wall they built the bridge to prevent the fire and coal from falling over the bars, so it is very apparent that a bridge was not to save coal or to sharpen the draught or to save the building of a proper or high chimney as is supposed by some of our engineers to-day. I have put together many furnaces within the past 60 years where the boiler was put on its bed, the front end was 20 inches from the dead-plate, and the back end was 8 inches from the brick or bridge, if you are pleased so to call it; the back end of boiler was one inch higher than the front end; the dome was straight up, and a centre line of the front end stood about the centre of the fire-door and ash-pit. I then divided the boiler end into three parts on each side of the centre line; two of these parts are enclosed in the fireplace with firebrick. At these points the firebricks were put on their edges, and the ends pushed against the sides of the boiler to stop the flame and smoke getting through. The wall here was set back 2½ inches, and was built up to the brackets on the boiler with pieces of boiler plate to move on when expanding. A thinner wall was built up above the top of the boiler to have bars put across, and on the top of those bars were plates of sheet iron, with bricks and mortar on top to keep in the heat, so that the boiler was enclosed as in an oven, with nothing touching it but the row on each side forming the fireplace. The reason why I divided the boiler end into six parts and took two into the fireplace was so that when the boiler expanded it would rise up and not push out on the brickwork, which can be renewed at any time from the inside, by taking out the bars and standing in the ash-pit. I built a large ash-pit, so that the air might be heated when entering the fire.

I have yet one of the boilers I set on this plan thirty years ago, and it is in good working order now, it has a good high chimney. I have others set on the same plan, but the chimneys are too low, so that I can only pass the heat through the boilers once.

I think if you could give us a good practical rule for building chimneys and setting boilers for every sort of coal and then the instruments could be applied so that our ordinary engineers could see where their defects are, it would be of use to all enquirers.

I have a boiler set in on the same plan three years ago, 14 feet long, 48 inches in diameter, with 35 tubes 4 inch. Since that time, or I

may say, within the last two years, I have had seven new tubes put into it, each one taken out showing all over pits eaten into it. This boiler has to heat about 6,000 gallons of water per day for washing. What shall I put into it to prevent the tubes from being pitted and eaten away? I have another hot water boiler throwing off thousands of gallons every day which has done so for many years past and not a tube has been moved nor have any other repairs been made My impression is that the new inventions for smelting the iron and making the tubes and boiler sheets are not so good as the old Low Moor iron was. They call it steel to-day. I fear they are squeezing and rolling up a lot of scraps and putting a gloss on it and calling it steel. The sooner we get back to good iron the better, as it will save great expense and many dangerous accidents, and remove the blame from many poor dead engineers, who did their best with very bad boiler material. Both the hot water boilers of which I speak are supplied with city water and from a tank above. A large cylinder stands between the tank and boiler to receive the cold and hot water of each. After losing five tubes I was persuaded to feed this boiler from both ends, which I did, but do not find any advantage, for I have had to put in two tubes since.

Yours truly,

P. TROWERN,

Chief Engineer, Asylum for the Insane, Toronto.

THE SARNIA GAS AND ELECTRIC LIGHT CO.

The electric light branch of the above company was established in 1894 and the plant was constructed during the summer of that year. The building, as will be seen by the accompanying illustration, is a handsome and substantial structure. It is built of red brick, with freestone trimmings and stone foundation, with basement under the engine and dynamo room, having truss roof, covered with iron, making the building practically fire-proof. Its dimensions are 34 x 72, with

POWER HOUSE.

octagon brick smoke-stack, 75 feet in height. The foundations for engine, dynamos and line shafting are of stone and brick set in cement, reaching through the main floor. The electric plant consists of one 75-light, Wood arc dynamo, with spare armature; one 30-kilowatt T.H. single-phase alternator, with 1½ K.W. exciter, and necessary switchboard apparatus. All of the electrical plant was installed by the Canadian General Electric Co., of Toronto and Peterboro. The incandescent light business has developed to such an extent that it has been found necessary to increase the plant, consequently an order was recently placed with the Canadian General Electric Co. for another of their standard alternators of 60-kilowatt capacity. About 750 lights are now wired up and the number is rapidly increasing, which speaks highly for the efficient service given. The arc line for street lighting required over 16 miles of No. 6 B. & S. wire and 10 miles of poles. There are seventy 1,200 c. p. lamps in use. The steam plant consists of a Wheelock engine 13x30; two steel boilers, one 60 inches by 14 feet, and one 66 inches by 14 feet, both of the tubular type, with all necessary shafting and friction clutch pulleys manufactured by the Goldie & McCulloch Co., of Galt. In order to further increase the capacity and efficiency of the plant, a 300 h.p. Northey duplex condenser and duplex boiler feed pump were installed during the past summer, taking water supply from the river through an 8-inch pipe. These improvements add easily 25 per cent. to the economy and efficiency of the plant. Besides the addition of another dynamo and boiler, new steam and smoke connections have been put in.

AN Ontario charter has been issued to William Lindsay, Brisbane, Australia; J. Joyce and R. I. Bradley, Petrolia; J. Marshall, J. Wallen, Oil Springs, as the Intercolonal Deep-Well Boring and Manufacturing Company of Petrolia, Limited, to drill wells and manufacture and sell drills and drilling machinery.

ACETYLENE GAS REGULATIONS.

The following is a copy of the restrictions imposed by the Canadian Fire Underwriters' Association, on the use of acetylene gas for illumination:—

1st.—That no calcium carbide or gas generating machine be allowed in any building insured.

2nd.—That generator must be placed in a separate building, constructed as follows, viz.:—Walls solid brick or stone not less than nine inches thick; roof entirely of iron or other fire-proof material; floor of cement or concrete with slight upward slope from door; entrance to be an iron or standard fire-proof door, no windows or other openings except for ventilation, which shall be through an iron pipe not less than six inches in diameter protected sufficiently through the roof and turned down at the outlet. Generators must be provided with escape pipes of sufficient capacity to allow gas to escape freely at a pressure not exceeding five inches of water. Care must be taken to deposit residue from generator at a safe distance from any building.

3rd.—That generator building must be located at least ten feet from a brick or stone building, or twenty feet from one of any other construction.

4th.—That the storage of calcium carbide be limited to three hundred pounds, to be kept in air-tight metallic cases not exceeding one hundred pounds capacity, and confined to the generator building.

5th.—That if the above regulations are not fully observed, double rates must be charged.

Industrial Notes.

SPOONER had his "Copperine" at the exhibition again.

CHRIST CHURCH, Listowel, Ont., is now lighted by acetylene gas.

A NEW bridge is to be built over the Mississippi River, at Glen Isle, Ont.

A NEW provisional jail is to be built in Nelson, B.C., to cost $14,000.

A NEW railroad bridge is to be erected by the C.P.R., at Kemptville, Ont.

Two of the six miles of pipe are now laid in the Perth, Ont. waterworks.

THE village of Iroquois, Ont., is putting in an electric light plant and waterworks.

THE Farmer's Elevator Co., of Lumsden, N.W.T., will build a 30,000 bushel elevator.

THE Peterborough Bridge Co. is building a new iron swing bridge, at Rosedale, Victoria county, Ont.

THE ratepayers of St. Thomas, Ont., will vote on a by-law to raise $40,000 for building a new city hall, on the 11th inst.

THE Smith's Falls, Ont., school trustees are to spend $1,000 on a system of ventilating and heating the central school.

THE rebuilding of the eastern abattoir, Montreal, on its former position is opposed by the municipality of Delorimier.

PEUCHEN & Co, Toronto, acetic acid manufacturers, are rebuilding their Tonawanda, N.Y., branch, recently destroyed by fire.

THE cement works of the Rathbun Co. at Napanee Mills, Ont. are very busy, and two new kilns are being erected at the works.

THE Heinze Pickling Co., Pittsburg, Pa., is negotiating for premises to open a branch in Canada, probably in Hamilton, Ont.

AT the recent exhibition at Sydney, New South Wales, the Canada Paint Company of Montreal was awarded first prize for paints and varnishes.

DAVID WHITE, Brantford, Ont., is superintending the erection of a sawmill at Bell City, Rainy Lake, Ont. It will be running by November 1st.

J. H. Ross, formerly employed by the Goold Bicycle Works, Brantford, Ont., has been appointed a boiler inspector, with headquarters at Orillia.

THE Edwardsburg Starch Works, at Cardinal, Ont., are running day and night, and are to be enlarged so as to double the capacity of the works at once.

A BREAK in the Montreal water main, which passes under the Lachine Canal at Atwater avenue, recently gave the city water department considerable trouble to repair.

J. U. Ross, Hamilton, Ont., has bought the Haggart works, Brampton, Ont., which have been idle for some years, and will manufacture threshing machines, engines, etc.

Architect Gauthier, of Montreal, has been instructed to prepare plans for building an $18,000 addition to the Catholic Church of St. Thomas, of Alfred, Prescott county, Ont.

The ratepayers of Gravenhurst, Ont., will vote in January on a by-law authorizing the expenditure of $16,000 on waterworks, $9,000 on an electric light plant, and $4,000 on a town hall.

Work on the St. Lambert, Que., water and sewage works is being pushed by the contractors, Drummond, McCall & Co., Montreal, the legal difficulties raised by the opposing ratepayers having been overcome.

The machinery at Toronto exhibition was lubricated with the Standard Oil Co's "Capital Cylinder," "Renown Engine," and "Atlantic Red Oil" from the Queen City Oil Co., Limited, Toronto.

Paquet & Godbout, St. Hyacinthe, Que, have been awarded the contract to build the new headmaster's house and gymnasium at Bishop's College School, Lennoxville, Que., and the plans have been prepared.

The Hamilton Powder Company of Montreal has placed an order with the James Cooper Mfg. Co., Ltd., for an Ingersoll-Sergeant piston inlet compressor, to be used at its Beloeil works for pumping and agitating acids.

The ratepayers of Springbank, N.W.T., are to vote on 14th inst. on a by-law to raise $40,000 on the security of their lands for the purpose of constructing a canal, laterals, flumes, reservoirs, etc., for the irrigation of the district.

The Canada Paint Company has recently in one week booked orders for over one hundred tons of colors and varnishes. This is another example of the superiority of Canadian products when brought into direct competition with foreign goods.

The Beacon Acetylene Generator Company, of Woodstock, Ont., lighted the Fair buildings at Woodstock, Ont., again this year with acetylene gas. Last year the results were very satisfactory, that being the first occasion when the new gas was used on a large scale in Ontario.

J. E. Whittaker & Co., St. John, are making rapid progress on their factory which is being built at Hampton, N.B. The main building, 100 by 40 feet, and the boiler house are nearing completion. Tinware will be manufactured, and an enamelling and graniteware department will be added shortly.

The machine shop business of Jonathan Weir & Son, Moncton, N.B., which has recently been conducted under lease by the Record Foundry and Machine Co., will in future be managed by John P. Weir. The firm will undertake mill work, boiler making, forging and repairs of all kinds. Engines will be built to order, and a specialty will be made of locomotive repairs.

New sewers have been recommended for the following streets in Montreal: St. Denis, from St. Ignace to the C.P.R. track; De Montigny, from Beaudry to Montcalm streets; St. Henry, from Notre Dame to St. Paul streets; Desrivieres avenue, its whole length; St. Andre, from Marianna to Mount Royal avenue, and from Mount Royal avenue to Perrault street.

The open season for most sorts of game is now on, but, of course, bonus hunting is always in. The Kingston *News* says in a recent issue: "The Wortman & Ward Manufacturing Company, of London, want a bonus of $12,000 and exemption from taxes to locate in this city. The board of trade will recommend the council to give them a free site and exemption from taxation without bonus."

Darblay, Pere & Fils, of Paris and Rouen, one of the largest pulp and paper-making firms in France, have had agents in New Brunswick recently making arrangements for a supply of spruce for pulp making. Export of pulp wood should not be encouraged, and if the large number of pulp mills now projected in New Brunswick are built, the supply for export will not be so great.

Many of the St. John saw mills are shut down on account of the American tariff changes, says the Fredericton, N.B., *Reporter*. Stetson, Cutler & Co.'s large mill at Indiantown is silent, and a large number of men are idle. Jordan's mill, at Pleasant Point, is shut down; Miller & Woodman's two mills, at Milford, are closed, and Chas. Miller's mill is shut down. Murray's, Cushing's and the Grand Bay mills are still running.

Chief Justice Armour dismissed the suit brought recently in the Civil Assizes by Launcelot B. Montgomery against the Toronto Mineral Wool Company for $1,000 damages. Montgomery was moving an engine for the company, when one of the jacks supporting it gave out, and the engine fell over against Montgomery, inflicting injuries to his knee and abdomen. Montgomery held that the company was responsible, having supplied him with defective appliances. The court held that he was an expert, and should not have used the defective jack.

Over 300 men are now employed in the C.P.R. car shops, at Perth, Ont.

F. Lemoine, Montreal, has been awarded the contract for the piers and abutments of the bridge at Edmonton, N.W.T., at $36,000.

The Jesuit Fathers will shortly build a very large college building in Westmount, Montreal

T. Smith has the contract for the Perth, Ont., pumping station building, to be completed by the 20th inst.

St. Henri, Que., recently voted $20,000 as a bonus to the Moseley Shoe Leather Company to establish a tannery.

In Berlin, Ont., I. E. Shantz & Co.'s foundry, H. J. Hall's woodworking factory and the Berlin Brush Co. are working overtime.

The Mooers Elevator Company, Kingston, Ont., has awarded the contract for the engine and boiler required for the elevator to the Goldie & McCulloch Co. of Galt, their tender being the lowest of seven.

Some time ago a dam was built on the St. Francis River at Drummondville, Que., which developed about 10,000 horse-power. So far very little use has been made of the power, and the townspeople are disappointed.

Harvey & Co., have their Newfoundland pulp mill ready for operation. It is expected that a number of other mills will shortly be erected if the first one proves a success, as it no doubt will, as Newfoundland has unlimited water-power and spruce wood.

The Robb Engineering Co. have received an order for three tandem compound engines, side crank type, for export to Spain. These engines are to be direct connected to electric dynamos, and were ordered by an English Engineering firm for electric tramways at Barcelona and Madrid.

A. L. Curry, of Curry Bros. & Bent, Bridgetown, N.S., is in Labrador in the interests of his firm. He is investigating the possibility of lumbering operations there on a large scale, for the purpose of shipping to Europe, and if his report is favorable, the firm will build mills there.—*Annapolis Spectator.*

Recently while J. J. Copp, a moulder at the works of Rhodes, Curry & Co., Amherst, N.S., was carrying a ladle of hot iron from the furnace, he spilled a quantity of molten metal inside his boot. Before the boot could be removed the foot was terribly burned, the flesh from the instep to the great toe being destroyed.

The Gravel and Construction Company, of Toronto, Limited, has been incorporated to construct public and private works, and deal in building and paving material, with a capital of $40,000. It is composed of A. Campbell, M.P., J. Smith and R. L. McCormack, Toronto Junction; J. P. McIntosh, Toronto, and A. H. Royce.

Walkerton, Ont., has captured one of Toronto's important industries, the business of the American Rattan Co. having been purchased by the Walkerton parties, who will remove it to that town. The price paid for controlling the stock is $75,000, and about 100 hands are employed, many of whom will remove to Walkerton. The company was established in Toronto ten years ago with ten year's exemption.

The contracts in connection with the new sewage interception works at Hamilton, Ont., were awarded as follows: Carpenter work, R. & J. Poag, $1,639; masonry excavation, etc., G. F. Webb, $5,699; machinery, A. J. Nie, $5,480; plumbing and steam heating, Fairley & Stewart, $633; roofing, J. E. Riddell, $897; painting, D. Kemp, $198; boilers, R. Quinn, $1,050; elevator, Leitch & Turnbull, $475; electric wiring, $130.

At Brantford, Ont., the Paterson Biscuit Company is working 24 hours a day, new machinery will be installed; the Verity Plough Works are working day and night, and contemplate making large additions to the works; the Massey-Harris Company which generally closes down altogether in September, is now running full time; the Cockshutt Plow Company recently built an addition larger than the original factory, and will shortly close down a few days to instal a new boiler plant.

R. A. Latimer. Montreal, carriage manufacturer's agent, has assigned at the demand of White, Chelloran & Buchanan; liabilities about $85,000. The principal creditors are: Canadian Carriage Co., Brockville, $13,073.13; Cossit Bros. Co., Brockville, $10,326.28; Brantford Carriage Co., $5,668.23; Wm. Gray & Co., Chatham, $4,287.79; G. M. Cossit & Bros., $3,934.57; Deering Harvester Co., Chicago, $3,541.94; McLaughlin Carriage Co., Oshawa, $2,300.82; J. W. Morin Mfg. Co., $2,852.50; Wortman & Ward Mfg. Co., London, $2,402.79; Wilkinson Plow Co., Toronto, $2,194.06; Chatham Mfg. Co., $1,807.42; P. T. Leger, Quebec, $1,000; Molsons Bank (securities), $10,878; Molsons Bank (mortgage), $3,802.73; Bishop's College, Lennoxville (privileges), $3,000.

ONE thousand shares have been subscribed in Shawville, Que., to sink a public artesian well.

THE Rathbun Company, Deseronto, Ont., has an order for 200,000 square feet of timber for the new railway bridge at Cornwall.

THE Toronto Paving Brick Co., Limited, has been incorporated, capital $190,000. The provisional directors are: A. E. Ames, J. Kilgour, A. A. McMichael, Wm. Crawford and J. B. Noble.

AN Ontario charter of incorporation has been granted to D. B. Wallace, Simcoe, Ont.; C. M. Richardson, G. Deighton, J. Flynn, and F. W. Hodson, Toronto, as the Winnipeg Heater Company of Toronto, Limited; capital, $24,000.

AN Ontario charter has been granted to H. C. Hunter, J. D. Wilson, J. J. Scott, Wm. Lees, and T. Hobson, Hamilton, as the Canister Machine Co., Limited, to carry on a packing business and manufacture cans and canisters, etc.

THE property of the Guelph, Ont., Norway Iron and Steel Co., Limited, failed to sell at auction on October 6th. It comprises a complete rolling mill plant, and about 80 tons of rails, boiler plates, etc. Jas. Naismith, Guelph, is liquidator of the company.

NOTICE is given by the Ontario Government that all companies not incorporated must before November 1, 1897, send to the Provincial Secretary returns of particulars relating to their work. Failure to comply with this means a fine of $20 a day, which will be levied, not only upon the company, but upon all directors, managers, secretaries, agents, travellers and salesmen, who with notice of such default transact in Ontario any business whatever for such company.

LORD MOUNT ROYAL wrote recently to the Minister of Trade and Commerce to lay before the Canadian lumbermen an opening for their product in London. He stated that almost the entire metropolis is paved with wooden blocks covered with a coating of asphalt. The blocks are described as "yellow deal," and are imported from Norway and Sweden. A single block of the yellow deal accompanied the High Commissioner's letter. If any Canadian firm were to undertake the experiment, the Canadian article could be tried in London, and possibly a very large trade worked up.

AT the meeting of the British Medical Association in Montreal recently, the question of sewage disposal was opened for discussion by a paper written by George Janin, C.E., formerly of the Corps de Ponts et Chaussees of France, and now of Montreal. The title of the paper was, "On the different processes recommended for the treatment of sewage—mechanical, chemical and epuration by the arable soil." In a concise manner the paper described the various attempts which had been made in other countries to purify sewage, with the indifferent results attending the same. This led up to purification through filtration or irrigation of permeable soil—a system of which Mr. Janin is an enthusiastic exponent. It was pointed out that enormous profits had been made from land on which sewage was poured in Germany and France Dr. Bryce, of Toronto, pointed out the success of the system at the London, Ont., Asylum, even in the coldest weather.

Mining Matters.

THE people of Shawville, Que., will sink a well in search of natural gas or petroleum.

THE Jenckes Machine Co., of Sherbrooke, Que., shipped last week a complete tramway plant to the Lucky Jim mines, at Sandon, B.C.

THE Foley Mines, Seine River, Ont., are now installing two 100 h.-p. steel boilers, built by the Jenckes Machine Co., of Sherbrooke, Quebec.

A REPORTER for a Quebec paper, on a recent visit to Jersey Mills, Beauce county, Que., washed a pan of dirt which gave 21 dwts. 9 grs. of gold.

AN extensive find of copper and silver-bearing ore is reported from Pugwash, N.S., on Canfield Creek. Wm. Murray is the lucky prospector.

THE boring for oil at Pelican Rapids, Arthabasca Landing, N.W.T., has been suspended after the shaft had been sunk 800 feet, the pipe having become choked with tar.

WM. MILES, who recently staked a gold claim in the streets of Victoria, B.C., opposite the post office, is meeting with a great deal of opposition in his attempts to work the lead.

THE 30-stamp mill at the Sultana Mines is almost ready to commence operations. This mill is probably the most modern one in the district, and the entire complete plant with which Mr. Caldwell is equipping the property was furnished by the Jenckes Machine Co., of Sherbrooke, Que.

AT Tache station, on the C.P.R., 135 miles west of Port Arthur, alluvial gold is reported. The finds are said to reach at least five cents to the pan.

SPECIMENS from Gainer Creek, near Ferguson in the Lardeau district, British Columbia, were recently assayed at Kaslo Sampling Works, and were found to be enormously rich in gold

THE Brookfield Mining Co., of North Brookfield, N.S., has placed an order with the James Cooper Manufacturing Co., Montreal, for a five-drill Ingersoll-Sergeant compressor, receiver, drills, etc.

THE Crow's Nest Mine, Melrose, N.S., has placed an order with the James Cooper Manufacturing Co., Montreal, for a duplex cross compound Ingersoll-Sergeant compressor, drills, receiver, etc.

THE Monte Cristo Mining Co., of Rossland, have made a fresh strike, and have ordered a complete new hoisting and pumping plant from the Jenckes Machine Co., of Sherbrooke, Que., which has been supplied from their Rossland stock.

THE statement that the Bannockburn Mining Company had taken over a large number of other mineral properties in Hastings county is unfounded. The company did take an option on several properties, but the arrangement has fallen through.

PROF. MILLER, of the Kingston School of Mining, was at Brudenell, Renfrew county, Ont., recently, assaying some mineral specimens which were brought in from the surrounding country. Large deposits of corundum have been found in this vicinity.

F. BLANCHARD, A. Barclay, R. and D. Mosher, Fort Frances, recently sold mining locations H. W. 54 and 87 to the Neepawa Gold Mining Co. for $16,000 cash. The property, which is situated in the Manitou district, near Blanchard Lake, is said to be very rich.

THE Hay Island Mining Co., Rat Portage, Ont., has placed an order with the James Cooper Manufacturing Co., Montreal, through the Rat Portage branch office, for a complete mining outfit, consisting of Ingersoll-Sergeant compressor, rock drills, hoisting engine, etc.

THE Old Ironsides Mine, at Greenwood, B.C., have got their new plant, which was furnished by the Jenckes Machine Co., of Sherbrooke, Que., into position, and are now about ready to ship ore. This property is expected to enter the list of dividend payers within the next few months.

THE agents of the Bank of Montreal in New York received last month from the Cariboo, B C., Hydraulic Mining Companies a cone of gold worth $61,987 and weighing 3,606 ounces. This is the second shipment from the company's mines this summer, the first having been a clean-up of $70,921 in July.

THE Cariboo, B.C., Gold Fields, which own ground for one and three-quarter miles of the bed of Williams Creek, has at present about one hundred men at work constructing a ditch, so that when completed this company will have about fourteen miles of ditches, with a capacity of 2,000 inches of water. The ditch is nine feet wide at the top, four feet at the bottom, and two and one-half deep, with a grade of 9.60 to the mile.

THE Hall Mines, Limited, Nelson, B.C., has placed an order with the James Cooper Manufacturing Co., Montreal, through the Rossland, B.C., branch, an order for another ten-drill Ingersoll-Sergeant compressor, and five more Sergeant drills. This is the third compressor plant that the Hall Mines Co. has ordered from this company, and when it is installed the machinery at the Silver King mine will have a capacity of twenty-five drills.

THE news of the new coal discovery in the Codroy valley, Newfoundland, is confirmed. The seam is over six feet wide, and the quality is reported to be equal to the best North Sydney. It is also stated that the Messrs. Reid, the railway contractors, on whose land concessions the seam is found, will commence working it at an early date. It is altogether probable that in these extensive Codroy valleys more seams will be found. The Hon. H. J. B. Woods says 60,000 tons are in sight.

DR. WOLFORD NELSON, F.R.G.S., New York, who was in Montreal for the meeting of the British Medical Association, visited the Calumet mines on the Ottawa River, opposite Bryson, Que. In referring to the Meyer mine on Calumet Island, Dr. Nelson stated that Charles L. Meyer, of New York, had associated with him E. P. Cowes, an American miner of large experience, and Leopold Meyer, of Madrid. This Meyer mine, he said, yielded a rich argentiferous galena, carrying a small percentage of gold. The Russell mine, near the Meyer property, furnished a zinc blend, which carried 13 to 15 ounces of silver per ton. From the 45-foot level of that mine a good ore was being obtained, and it was bagged and shipped to Swansea, in Wales. The general outlook at Calumet, Dr. Nelson remarked, summing up the result of his visit in a few words, was exceedingly promising.

WM. KIRBY, Callendar, Ont., reports a find assaying $18 per ton in gold at that place.

SOME exceedingly rich finds of free gold are reported from around Lytton, B C.

THE boring for oil at Fredericksburg, Ont., has been abandoned at a depth of 550 feet.

THE Harvey Hill copper mine, Megantic county, Que., has been closed, owing to the new duty.

THE coal mines at Lethbridge, N.W.T., will produce 12,000 tons per month during the winter.

VERY rich finds of placer gold are reported from the north fork of the McMillan River, another tributary of the Yukon.

AT the Dalhousie gold mine, near Lanark, Ont., the shaft is now sunk to the depth of forty feet and gives good indications of gold.

J. M. DOUGLAS, M.P., for East Assiniboia, reports at Winnipeg the discovery of a seam of what is claimed to be anthracite coal, on the Qu'Appelle River, near Wapella.

Now that there is some question of the iron ore deposits of the Bilbae district of Spain giving out, or becoming leaner, it might be advisable for our ironmasters to investigate the iron ores of Newfoundland. According to Dr. Grenfell there are immense—even unlimited—quantities of hematite ores of excellent quality at Bell Island, magnetic iron and pyrites in many places, and chrome-iron ore in abundance at Port-a-Port. There are also deposits of nickel ores, asbestos, copper, coal, etc., in many parts of this our oldest and nearest colony. We ought not to let these minerals drift into the hands of American firms.—*The Ironmonger, London.*

REPORTS to THE CANADIAN ENGINEER from the Wabigoon district show that mining business is rather dull there at present. As investigation proceeds it becomes evident that there are some promising properties there, but a good deal of money needs to be spent before the extent of value of the claims can be determined. One difficulty is that a number of the claims are in the hands of men whose capital is too small to develop them, and another is that speculators are holding their claims at figures that are altogether too high, when it is considered that many of the properties will prove on development to be non-paying.

GREAT progress is being made at the Foley mine, Rat Portage, Ont. A contract has been let to the Canadian Rand Drill Company, Montreal, for what will be the largest mining plant in the Rat Portage district. The compressor has compound steam cylinders operated in conjunction with a condensor. Air is to be conducted all over the different workings, so that when completed, operations may be carried on all over the property by means of compressed air as a power. As these workings are scattered, the change will do away with the use of several small boilers and effect a very considerable saving in the fuel bill and the pay roll.

How little is done for the country by even a mine whose ore is hlghly refractory, is shown by the following picture of the advantages accruing to Rossland, B.C., from the Le Roi mine: "The $50,000 paid as dividends every month to the stockholders of that mine do not reach Rossland, at least not much of it. It is paid in Spokane, mostly to Spokane people. All the miners are compelled to board at the company's boarding-house, and all the supplies for that boarding-house are purchased in Spokane. Many of the men have wives and families in the States, and the greater portion of their wages is sent to their families, so that Rossland derives very little benefit from its biggest mine."

DURING the past month the James Cooper Manufacturing Co., Limited, of Montreal, has supplied the following mining plants:—Canadian Goldfields Syndicate, Rossland, B.C., for Sunset Mine, a 7-drill Ingersoll-Sergeant compressor with full complement of Sergeant drills, boiler, hoisting and pumping plant; Ruth Mines, Sandon, B.C., a 5-drill Ingersoll-Sergeant compressor, necessary complement of Sergeant drills, boiler, and all accessories; G. Alexander, Kaslo, B.C., for Northern Bell and Jackson Mines, a 3-drill compressor, full complement of drills, etc.; Burley Gold Mining Co., Rat Portage, Ont., Ingersoll-Sergeant compressor, Sergeant drills, double compartment shaft hoisting engine, etc.; Guffey-Jennings Mining Co., Cariboo, N.S., an Ingersoll-Sergeant five drill air compressor, drills, etc.

SPEAKING of the enormous electrical power in the neighborhood of Cornwall, Ont., a contemporary says: "With 1,000,000 horse-power at Massena and almost unlimited power on this river, furnished by the Cornwall Canal through the Sheik's Island reservoir, an international bridge and railways running north and south and east and west, on both sides of the river, this section of country offers unsurpassed advantages for manufacturing industries and general commerce."

Electric Flashes.

THE Royal Electric Co. is doing the lighting of the Montreal Post Office building.

THE long-distance telephone between Ottawa and Boston is now complete.

AT Vernon, B C., a by-law to raise $12,000 for an electric light plant has been carried by the ratepayers.

GEO. WILSON town clerk, Glencoe, Ont., calls for tenders for the electric street lighting of the town for a term of five years.

THE Electrical Supply Co., of Hamilton, Ont., Limited, has changed its name to Electrical Power and Manufacturing Co., of Hamilton Limited.

R. C. C. TREMAINE and others, of Exeter, Ont., have been incorporated as the Exeter Electric Light and Power Co., Limited; capital, $15,000.

THE street railway in Victoria, B.C., is being greatly improved. Government street is being double-tracked, and a large number of new motors brought into use.

A BOILER explosion occurred recently at the Chambers Electric Light Works, Truro, N.S. The fine new engine lately put in was seriously damaged. None of the employees were injured, though there were some narrow escapes.

WILLIAM BATHGATE, for 14 years manager of the Electric Light and Gas Company, Winnipeg, Man., has resigned, the company having been amalgamated with the Electric Street Railway Company. No successor will be appointed.

THE directors of the Halifax Street Railway have decided to issue an additional $200,000 worth of stock. This will make the capital of the company $800,000. The new stock will be issued to shareholders on record in the proportion of one share to every four held. A quarterly dividend of 1¼ per cent. was paid Oct. 1st.

THE Bridgewater Power Co., Bridgewater, N.S., has lately been reconstructing and enlarging the electric light plant, and has replaced their three-wire system by an alternating current system, for which purpose they they have purchased a 40 K. W. "S.K.C." two-phase generator from the Royal Electric Co., and 600-light capacity in transformers.

GEO. EASTERBROOK, who is about taking his departure for Delago Bay, South Africa, where he is erecting flouring mills and other industries for a wealthy syndicate of Canadians, is taking with him a complete electric lighting plant. The apparatus and material complete are being purchased from the Royal Electric Co. This, we believe, is the first instance where a Canadian electric lighting plant has been sold for service in the antipodes.

THE Kingsville Electric Light Co., a corporation recently organized in that town, has decided to light the town, stores and residences by electricity, displacing natural gas, and for this purpose has bought from the Royal Electric Co. an "S K.C." 500 light two-phase generator, with the necessary transformers and material requisite to wire up 500 lights, which is the amount intended to start work with. The Kingsville Electric Light Co. has made a contract by which it will use natural gas for fuel. It is intended to furnish incandescent and arc lights, as well as motors.

THE Cockshutt Plow Co., of Brantford, have bought additional premises, and are doubling the capacity of their works. Among the important changes being made is the substitution of electricity for gas. They have placed their order for a 30 K. W. Generator and 250 lights installed, with the Royal Electric Co. The generator is to be of the "S.K.C." two-phase type, wound to deliver 110 volts direct to the mains. This system for isolated lighting is a radical departure from the old lines, and is the second instance in Canada where it has been placed in use for factory lighting.

THE Penman Manufacturing Co., Paris, Ont., which operates some of the largest mills in Canada, has made a number of improvements and additions to the mills in Paris lately, and among the improvements has decided to light their mills by electricity. The contract for a 500 light "S.K.C." machine and the wiring of the factories has been awarded to the Royal Electric Company, which purpose using for this its "S.K.C." two-phase alternating current apparatus; the dynamo wound to deliver to the mains current at a pressure that can be used directly in the lamps, from 100 to 115 volts. This is the first instance in Canada where alternating current is used for factory lighting. It has been held heretofore by electrical manufacturers that it was not practical to use alternating current for factory lighting. This plant will be a demonstration of the incorrectness or otherwise of the theory.

E. W. CUMMINGS is engineer in charge of the water-power development of the Kootenay, B.C., Electric Co.

THE ratepayers of Lanark, Ont., recently expressed themselves at a public meeting as strongly in favor of the Lanark county electric railway.

THE electric plant belonging to R. Prefontaine, at St. Agathe, has recently been considerably enlarged; a new dam and power-house have been built.

THE London, Ont., Street Railway and the London township council have come to terms, and the street railway extension to Pottersburg is to proceed at once.

C. B. MCALLISTER, Peterboro, Ont., is lighting his new flouring mill by electricity, and has placed his order for the dynamo and fixtures with the Royal Electric Company.

AT Magog, Que., a special committee of the town council has reported in favor of borrowing $10,000 to purchase an electric light plant and develop the water power.

IT is reported that Duncan McDonald, superintendent of the Montreal Street Railway, will shortly assume the duties of General Manager of the Toronto Street Railway.

AHEARN & SOPER, Ottawa, will build the telegraph line on the New York and Ottawa Railway from Ottawa to Moira, N.Y. It will include a cable across the St. Lawrence River.

A. W. PETTES and E. E. Mills have arranged with W. Foster, Knowlton, Que., for the power to run the electric light. It is intended to give an all-night service to residents and on the street at a reduced rate.

THE Stevens Manufacturing Co., London, Ont., advertises for sale in another column, a number of machines in good running order which have been replaced by its improved Eastern or Imperial apparatus.

AN English syndicate with large capital is said to be negotiating for the purchase of Canadian lighting companies, both gas and electric. The purchase of Fredericton, N.B., gas company is said to be under negotiation.

AN Ontario charter has been granted to F. N. Saylor, G. M. Haldane, J. C. Scott, A. Reed, H. McColl, Strathroy, Ont., as the Strathroy Electric Co, Limited, to supply heat, light, and power; capital, $20,000.

THE Hamilton Board of Works recently put through the Hamilton, Chedoke and Ancaster Electric Railway by-law of incorporation. It gives the road the right of way on Queen street south from Aberdeen avenue to Beckett's Mountain-drive. At Aberdeen avenue the H., C. & A. is empowered to cross the H. & D. line and run along the street railway tracks from Herkimer street to James and King. The new road has to be running by 1899, and will have a charter of 20 years.

H. M. WHITNEY, Boston, Mass; F. S. Pearson, New York; James Ross, Montreal; Wm. McKenzie, Toronto; W. B. Ross, Q.C., Halifax; R. C. Brown, Halifax; B. F. Pearson, Halifax; R. D. McGibbon, Q.C., G. C. Cunningham, and W. B. Chapman, Montreal, have secured a charter and franchise from the Jamaica Government to build electric tramways on the island, which will need $500,000 capital or more. Montreal and Halifax capitalists are to furnish most of the money. The earliest construction will be in the city of Kingston and its suburbs. A large power house will be built on the foreshore, and electric lighting will also probably be provided.

THE Dominion Government has recently, under the superintendency of D. H. Keeley, C.E., completed forty more miles of the telegraph line on the north shore of the St. Lawrence from the former terminus at Pointe Esquimaux, and an office has been opened at Piastre Bay. It is intended to extend the line 488 miles more to Natashquan, where an office will be opened this Fall. The North Shore line will still be about 250 miles from Belle Isle, but it is the intention to complete this section as rapidly as possible, so that the entrance to the Straits of Belle Isle will be in direct telegraphic communication with Quebec and Montreal

THE Berlin, Ont., Gas Co. has been operating an incandescent lighting plant on the three-wire system, but are now extending the incandescent lighting service so as to furnish light to the residential portion of the town. It has been decided to use alternating current, and the order has been placed for the new equipment with the Royal Electric Co., using the "S.K.C." system throughout. Extensive alterations have been made in the station, and there are now in position two 100 k.w. Edison 500-volt generators for furnishing current to the Berlin and Waterloo Street Railway. The company also operates a local power service from its three-wire low tension system besides furnishing the town with arc lamps, for which purpose it operates two 50-light, 4 amp. Ball dynamos.

THE proposed purchase of the Chemong and Lakefield railway lines and their conversion into electric roads, which is announced as being under negotiation, would mean a great deal for Peterboro, Ont.

THE Whitney Electrical Instrument Co., of Penacook, N.H., and Sherbrooke, Que., have issued the following circular to their patrons in Canada; "We beg to inform our friends and patrons that C. E. Shedrick will hereafter manufacture and sell our line of apparatus in Canada. In transferring to him this branch of our business, we bespeak for Mr. Shedrick a continuance of the very cordial relations that have always existed between our customers and ourselves, assuring them in advance of an honorable and business-like treatment at his hands." We may add that Mr. Shedrick will have sole control of the manufacture and sale of the well-known Whitney electrical measuring instrument in the Dominion. He has been manager for the American Company for the past five years, during which he has worked up a large business, and now starts on his own account with a thorough knowledge of the trade, and the good will of a large clientele. Mr. Shedrick has a well-equipped laboratory of his own, and has been the inventor of a number of very ingenious devices in the way of electric alarms, regulators, etc. In addition to the manufacture of the Whitney instrument, he is sole maker in Canada of the celebrated Knott X-ray and therapeutic machines. The factory will remain at Sherbrooke."

Railway Matters.

A CENTRAL office building for the G.T.R. in the business portion of Montreal is spoken of.

THE Baie des Chaleurs Ry. Co., has succeeded, it is said, in raising the money to carry on construction.

W. NEWCOMBE, Hamilton, Ont., has been appointed road foreman of the locomotive department of the G.T.R.

OWING to the increased business on the C.P.R., 200 flat cars have been ordered from Rhodes, Curry & Co., Amherst.

THE C.P.R. has placed an order for 100 box cars with Crossen & Co., of Cobourg, Ont., who have been delivering in Toronto at the rate of five per week, commencing Sept. 13th.

THE G.T.R. has decided to build a thousand box cars for freight traffic. Of this number 500 will be built in Canada at the shops in Montreal and London. The other 500 have been contracted for in the United States.

THE directors of the Quebec Bridge Company are calling in twenty-five per cent. of their subscribed capital before November 15th. Meanwhile the work of verifying the soundings at the proposed site between the Chaudiere and Sillery is being actively pushed forward.

J. B. MCARTHUR, president of the Rossland, B.C., Board of Trade, said after a recent conference with Mr. Shaughnessy, vice-president of the C.P.R., that the C.P.R. will build a line to Rossland at once, and capitalists connected with the company will erect a smelter there, so that Canadian ore can be smelted in Canada.

THE Canadian Pacific Railway Company has completed surveys for steam tramways to be constructed across the portages, and connect Lake Wabigoon with the Manitou chain of lakes and the latter with Rainy Lake, giving easy facilities for transportation of supplies to all points in the Manitou and Seine River mining regions, and also completing a circuit from Rat Portage to Wabigoon.

THE I.C.R. extension to Montreal is being rapidly pushed. The grading is now completed, and the rails will shortly be laid, and construction trains can run through from Levis to St. Hyacinthe. There are six trains and six hundred men employed on the extension; the masonry on eleven bridges is progressing rapidly; three new stations are being built, and the manager says there will be no trouble in opening through traffic on November the first.

THE Robb Engineering Co., Amherst, N.S., has just constructed and tested a locomotive for the new Pole Railway, running from Weymouth, Digby county, to New France. It resembles an ordinary locomotive, boiler and engine mounted on a flat car, the wheels of which are concave to fit the wooden rails of the road, which are about a foot in diameter. Some years ago McPherson & Co., of Oxford, made one for the Fossil Flour Company, of Bass River, but this boiler was of the upright pattern.—*Colchester Sun.*

A REMARKABLE test of a recently patented train signal was made a short time ago on one of the Canadian Pacific stock trains between Winnipeg and Montreal. This new device—the invention of Rev. Prof. Devine, S.J., of St. Mary's College, Montreal—enables railway companies to use electricity for signalling purposes, instead of the bell-rope or compressed air. Prof. Devine claims for his train signal three

important functions: First—It enables trainmen to keep up communication between the van and engine while trains are in motion. Secondly—On long freight trains, signals may be given instantaneously to front and rear trainmen from any car in the train. Thirdly—Danger signals are given automatically to front and rear directly a train breaks in two. The reverend professor personally superintended the recent successful test on the Canadian Pacific.

THE Canadian Pacific Railway have nine parties in the field at present locating the line of the Crow's Nest Pass Railway. The following well-known Eastern engineers are in charge of these parties: Chas. Garden, of Winnipeg, and E. Force of Ottawa, are locating the line west of the Pass to Michael Creek. Wm. McCarthy, of Ottawa, and Wm. Burns, of Renfrew, are completing the location along Elk River west to the crossing. H. W. D. Armstrong, of Toronto, is working between Elk River and Kootenay River. G. H. Garden, of Montreal, is closing up his work between Fort Steele and Cranbrook. W. S. Cranston, of Ottawa, is locating some heavy work along Moyie Lake, and W. J. Earl and G. Hannington, of St. John, N B., are locating the line between Moyie Lake and West Kootenay. The location of the line will soon be completed to West Kootenay.

THE reported discoveries of very rich gold bearing quartz in the Michipicoten district of Ontario are yet unconfirmed. While there is certainly gold there in considerable quantities, the extent of the deposits will not be known till Prof. Wilmott, who has been sent out by the Ontario Government, makes his report.

FIRES OF THE MONTH.

Aug. 31st.—G.T.R. station, at Deseronto, Ont.——Aug. 31st.—A. H. Davidson's saw mill, Colpoy's Bay, near Wiarton, Ont.——Sept. 5th.—W. N. Roberts' sash and door factory, Renfrew, Ont. Loss, $15,000. ——Sept. 7th.—David Donaldson's planing mill, Lanark, Ont. Loss, about $4,000.——Sept. 17th. McMillan's 30,000. bushel elevator, at Emerson, Man. Loss, $15,000.——Sept. 17th.—The St. Maurice Lumber Company's saw mill, Three Rivers, Quebec. Damages, $80,000; insurance, $40,000.——September, 20th.—The Hull Lumber Co.'s mill, Ottawa. Loss, about $100,000.——Sept. 20th.—The Goldie Milling Co.'s cooper shop, Highgate, Ont. Loss, $400.——Sept. 21st.—Terreall & Racine's foundry, Quebec, moulding shop and pattern room. Loss, $15,000.—— Sept. 24th.—Damages to extent of $1,000 to the moulding shop of Kingston foundry. ——Sept. 28th.—Gillies & Co.'s shingle mill, Sand Point, Ont. Loss, about $8,000.——Sept. 29th.—Perry & Black's sawmill. Fergus, Ont. Loss, $1,200.——Oct. 4th.—Damage to Central Prison, Toronto, twine and broom factories, $80,000.—Oct. 5th.—Damage to Graham Nail Works, Toronto, amounting to $150.

Personal.

P. S. ARCHIBALD, C.E., late chief engineer I.C.R., is practising as a consulting engineer.

I. C. BURPEE has been appointed to succeed W. B. Mackenzie as assistant engineer, I.C.R.

H. M. JACQUES, B.A.Sc., has been appointed demonstrator in mining, in McGill University.

THE death occurred recently at Truro, N.S., of James Odell, C.E., at the advanced age of 75 years.

ALEX. BEGG, editor of the *British Columbia Mining Record*, is dead, at Victoria, B.C., aged 65.

JOHN STARK, a boiler-maker in the C.P.R. shops, Toronto Junction, was run over and killed by a train at Guelph, Ont., recently.

J O. Wisner, who was one of the earliest manufacturers of agricultural implements, in Brantford, Ont., died at his home there, Oct. 3.

ROBERT PATTERSON, who resigned his position as engineer at the Hamilton General Hospital to go to the Klondyke, was drowned in the Athabasca.

E. HAY, a member of the Amalgamated Society of Engineers, who was employed as engineer by the Montreal rolling mills, died suddenly, Sept. 24th.

THE governors of the Kingston, Ont., School of Mines have appointed H. R. Landis, New York, mining engineer for one year at a salary of fifteen hundred dollars.

M. F. CONNERS, B.A., Sc., analyst and assayer, Bank Street Chambers, Ottawa, whose card appears in another column, announces that he is prepared to make analyses and assays of ores, minerals, etc.

THE chair of mining engineering, at the Kingston, Ont., School of Mining, has been filled by the appointment of Courtney De Kalb, who lately resigned a similar position in the Rolla School of Mines, in Missouri, U.S.

F. J. RASTRICK, architect and civil engineer, died on the 13th September 13th, at his residence, in Hamilton. He was a native of Staffordshire, England, and had resided in Hamilton since 1853 He was a member of the council of the Ontario Association of Architects, Toronto, and was instrumental in establishing the Public Library and Art School in Hamilton.

Marine News.

J & R. WEIR, Montreal, recently launched a tug which they built for W. Davis & Sons, contractors.

A. DEVOE, Cape Breton, and John F. Devoe, of Little Bras d'Or, have invented a one blade spiral propeller.

JOSEPH L'ETOILE, of Ottawa, has invented a submarine searchlight which was, it is said, successfully tested in the Ottawa River recently.

THE amount of freight handled this year by the steamers plying between Toronto and Montreal, is the largest in the history of both the R. & O. Navigation and Merchant Line steamers.

POTTER BROS., of Canning, N.S., have completed their steamer the "Beaver," which will at once be put on the route between St. John, N.B., and Parrsboro, Canning and Wolfville, N.S.

IT is said in London that Sir Weetman Dickinson Pearson's company has submitted a proposal to complete the canal from Ottawa to Georgian Bay, on conditions which are believed to be satisfactory.

CAPT. COATES, Fort Frances, Ont., and Capt. Mosher, are building another steamer, "City of Alberton," for service on Rainy Lake. It will be somewhat similar to the "Maple Leaf," but a little more elaborate in finish.

PLANS and specifications are out for the construction of a very large barge to carry coke-laden cars from Comox to Vancouver, B.C. The craft, which is to be built for the Messrs. Dunsmuirs, will be capable of receiving twelve loaded cars at a time. It will be 190 feet long, and will have a beam of 45 feet.

A CHANGE has been announced in the eastern terminus of the Canada Atlantic Railroad from Rouse's Point, N.Y., to Swanton, Vt., and the extension of the line west from Ottawa to Parry Sound, by which it is proposed to open a new trunk line between the great lakes and New England points. It is stated that a line of steamboats will be run from Chicago to Parry Sound, and at Swanton the Canada Atlantic will connect with the Central Vermont and the Boston and Maine Railroads.

MR. MARGARCH, the Government engineer, has recently returned from Manitou, where he has been building a dam, which enables vessels of four feet draught to get within seven miles of Rainy Lake, thus making navigation possible over a distance of sixty miles. Instrucsions have also been received from the department instructing Mr. Margarch to go on with the building of another dam at Dryden, on Wabigoon River, which will raise Lake Wabigoon to high water level and make another stretch of forty miles of water navigable. So that from the track to Fort Frances can be reached by making two portages only. There are now four steamers on the Wabigoon, and one on the Manitou.

A. P. Low, of the Geological Survey, who went to Hudson Bay last spring with the "Diana," has returned to Ottawa. The "Diana" entered Hudson Strait on Jubilee Day, June 22nd. On July 6th, she met thick weather, and was fast in an ice pack; on the 9th she reached loose ice, and on the 12th clear water in Hudson Bay. On July 16th, Mr. Low's party were landed near Douglas Harbor, a place Mr. Low describes as affording first-rate shelter. On the 18th, the "Diana" steamed away and Mr. Low set forth on his coastwise journey eastwards. On the 26th their yawl became fast in the shore ice and remained until Aug. 1st. It was on Aug. 1st the party reached Stupart's Bay, where some years ago the observer, after whom the place is named, established a station. The party reached the southernmost part of Ungava Bay on Aug. 24th. There at Fort Chimo they found the Hudson Bay Company's steamer "Erik," which had arrived on the 20th from Fort Churchill on the west coast of Hudson Bay, the earliest passage on record. The captain reported, however, that the ice pack had been the most formidable in his experience of six years' navigation of these waters. From Fort Chimo, Mr. Low made a trip in his sail boat across to George River, on the east side of Ungava Bay, returning on Sept. 7th, Next day the boat and her outfit were put on the "Erik," which took them out of the strait and around to Nachvak on the Atlantic coast. Dr. Bell and his party made a very successful survey of the coast. They also traveled for seven days into the interior of Baffin Land, and discovered an immense lake over 80 miles long. He further explored the region for gold, but found nothing of much practical use.

THE Kootenay River and Transportation Company has a steamer well under construction at Jennings, B.C., for the Fort Steele trade on the Kootenay. She will be 150 feet over all, 30 feet beam, tonnage 250. Her cylinders are 12 inches in diameter, 12-foot stroke. There will be 22 staterooms, electric lights, searchlight, etc.

THE work on the new steamer now building at the shipyard, at Belfast, Ireland, for the service between Liverpool and America for the Dominion Line, is progressing favorably, and the ship will be delivered at Liverpool on April 1. The Dominion Line have decided to name the new steamer "New England" instead of "Dominion," as was at first intended. The "New England" will be 50 feet longer than the "Canada," three feet wider beam and two feet more depth of hold. She will carry a cargo of about 15,000 tons measurement. She will have more passenger accommodations than the "Canada," the first cabin staterooms being more spacious and somewhat of an improvement in the way of furnishings and decorations.

A NEW town site is being surveyed on the shores of Lake Winnipegosis, where the Dauphin Railway will terminate.

H. CORBY, of Belleville, is lighting his distillery and warehouses with electricity, and has placed his order for the dynamo, etc., with the Royal Electric Co.

THE Jenckes Machine Co., Sherbrooke, shipped recently one of its heavy 50-h.p. slide-valve engines, with standard steel tubular boiler, to Desire Thibault, East Hereford, Que.

D. CHAMPOUX & BRO., Disraeli, are installing an electric lighting plant, and have purchased for this purpose a 30-inch Crocker Turbine from the Jenckes Machine Co., of Sherbrooke, Que.

THE Ottawa lumbermen have been notified by the Minister of Marine and Fisheries that the law forbidding the dumping of sawdust into rivers will be enforced at Ottawa after July 1st.

THE power station for the Sherbrooke Street Railway, at Sherbrooke, Que., is rapidly nearing completion, and the turbine plant being installed by the Jenckes Machine Co. is also about completed.

THE Chicoutimi Pulp Co. is adding another 40 inch Crocker turbine, arranged to work under 70 foot head, which is being supplied by the Jenckes Machine Co, Sherbrooke, making the fourth of these wheels supplied.

THE dam at Magog, Que., for the civic electric light plant is completed, and the 55-inch Crocker water wheel, which is being furnished by the Jenckes Machine Co., Sherbrooke, is expected to be installed now within a short time.

THE screens and wet presses furnished by the Jenckes Machine Company, Sherbrooke, are now arriving at the Morgan Falls mills of the Acadia Pulp and Paper Co., and the whole plant is expected to be in operation within a short time.

THE Dominion Paper Co., which is extending and enlarging its mills at Kingsey Falls, have placed an order with the Jenckes Machine Co., Sherbrooke, for two of their 30-inch Crocker special turbine wheels. These wheels are mounted on one shaft, set horizontally in a steel case, thus doing away with gearing and attendant evils.

WATER was turned into the flume at the factory of the Boston Rubber Co. at St. Jerome on the 25th ult. The steel flume, which is 350 feet long, 6 feet in diameter, was furnished complete, including a 55-inch Crocker wheel, by the Jenckes Machine Co., Sherbrooke, Que.

THE Shawenegan Falls on the St. Maurice, have been sold at auction for $50,100 by the Quebec Government, Sept. 9th, to D. Russell, Montreal, representing a syndicate which will produce calcium carbide. Within 18 months $4,000,000 will be expended in development. The power reverts to the Government on failure to fulfil these conditions.

WM. WATSON, Toronto, recently visited the Penetanguishene Hotel at Penetang, and made a thorough inspection of the sewage disposal works. Mr. Watson reported the plant as of admirable design and construction, and only requiring careful operation to make it a complete success.

MARSH & HENTHORN, who succeeded to the business of the G. & J. Brown Mfg. Co. of Belleville, have been very successful since they took over the establishment last summer. They have made 20 lumber cars for Gilmour & Co.'s yards at Canoe Lake, Ont., and 15 cars for the Soulanges Canal. They have supplied four steam hoists to Wm. Gibson, contractor, two for the quarries and two for work on the Victoria Bridge, Montreal. The quality of their work has been very favorably commented on.

"MINERAL Wealth of Canada," by Arthur B. Willmott, Professor of Natural Science in Macmaster University, has just been issued from the press of Wm. Briggs, publisher, Toronto. It is a guide to the study of the economic geology of Canada. The ordinary student of the mineral deposits of Canada has not the opportunity of digesting the contents of the reports of the Geological Survey, but this work of 201 pages contains in a small compass the main facts conveniently arranged and in language as plain as can be employed. One good feature is that not only is each mineral found in Canada described, as it were, in a "character sketch," but an account is given of the uses to which it is put, and where it is found in Canada, as far as known. A list of authorities on each topic is given for the convenience of those who wish to follow up the subject more fully. The topics treated of are iron, manganese, chromium, nickel, cobalt, copper, sulphur, gold, platinum, silver, lead, zinc, arsenic, antimony, tin, aluminum, mercury, salt, gypsum, barite, apatite, mica, asbestos, actinolite, talc, peat, coal, graphite, petroleum, asphalt, albertite, anthroxalite, granite, sandstone, clay, slate, limestone, marble, lithographic stone, cement, fertilizers, etc. Recent statistics of production are given in most cases.

THE most interesting catalogue on acetylene gas generation yet issued is that of the Niagara Falls Acetylene Gas Machine Company of Niagara Falls, Ont. Besides a description of the method of manipulating the machine, it gives a variety of useful notes and statistics relating to the properties of acetylene as an illuminant. Those interested in the subject will find many valuable points in this catalogue, which will be mailed free on application.

IN the June issue of THE CANADIAN ENGINEER a selected paragraph appeared which gave the error recently established in the longitude of Montreal incorrectly. We append the correct figures, as contained in Prof. McLeod's report: "The final value of the longitude of Montreal (the middle point between the two piers of the transit instruments at this observatory), as determined from the observations of Professors H. H. Turner and C. H. McLeod in 1892, is 4 hours, 54 minutes, 18.67 seconds. This quantity is in excess of the old value, which was obtained by connection with the United States system of longitude, by 0.105 of a second. The determinations upon which the American longitudes have hitherto rested were made by the United States Coast and Geodetic Survey in 1866, 1870 and 1872. When it is considered that the cable signals were then sent by the old flash system, and that the longitude operations, as conducted by the Americans, did not include an interchange of observers, the accordance of the old value with that above announced is quite within the limits of error, which might properly have been assigned to the former."

A VERY interesting experiment with asbestos plaster took place recently, at Washington, in the northwest court of the United States Treasury Department building. It was a practical demonstration of the merits of this plaster for the benefit of the officials of the Supervising Architect's Office. Those present were Mr. Bouche, chief computer; Mr. Raymond, in charge of testing and experimental work; Mr. Adams, chief of the heating and ventilating department, and Chief Engineer Watts. In the court was placed a structure representing a miniature house, the roof of which was about four feet high, the interior being plastered with "asbestic," the name by which this new wall plaster is known. Around the structure were piled kindling wood, shavings and paper enough to make a bon-fire to celebrate a great political victory. After being ignited, the light structure was immediately enveloped in flames, which burned fiercely and furiously, but to no avail, as they had found a master. After being subjected to the fire for half an hour an important test was made. A stream of water, through a one and a-half inch nozzle, was poured on the plaster attached to the sides and roof without any effect. The plaster did not drop or crack, but was intact, demonstrating conclusively that it was fire-proof and far superior, in every way, to any plaster now on the market. Asbestic is manufactured by the H. W. Johns Manufacturing Company of New York.

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAPTER IV.

ARTICLE 11.—SURVEYS.

The final determination of the exact centre line of a railway roadbed and track is only reached after a process of sifting, which extends from the first thought of the necessity for such a railway until the track is laid. Roughly speaking, it is usual to divide the operations into three stages, which, however, often overlap each other, or are again divided into subsidiary steps. These customary general divisions are:

(1) Reconnaissance.
(2) Preliminary or Trial Line Surveys.
(3) Primary and Revising Location Surveys.

ARTICLE 12.—RECONNAISSANCE.

Reconnaissance may be said to begin after it has been decided that there is a necessity for a railway between two given terminals, or along a given route.

In the latter case, local considerations, or the shortness of the distance, or the existence of a definite water line route, may limit the scope of explorations, but looking to the larger problem, where an engineer has to determine what is the best route between two terminals several hundred miles apart, the study is interesting and one requiring a high order of talent. If the country to be traversed is unsettled, or thinly settled, the problem is simplified by lack of railway competition often, or even by considerations of traffic, but it then demands a close investigation of the natural resources of the country, which, though dormant, will be developed by the railway itself, and it might be considered best, all things considered, to build sometimes, at a sacrifice of distance, grades, or capital outlay, through a country of great natural resources, rather than through a barren one by a route physically superior. On the other hand, through a populous country, the question is much more complex, by reason of the existence of other railway routes already established; but, on the other hand, simplified by a more or less well defined trend of population, which indicates the probable future distribution of people in accordance with natural laws. For these and many other reasons, exploration should commence and be well under way, or even completed, before instrumental work commences; it should, at least, be completed for such a distance that some critical place has been reached through which the final location must pass.

In order to finally fix on the best route between two defined points, it is necessary to study a wide belt of country; even a great number of trial routes will not answer so well, because portions of various routes may be finally selected and joined together. In order to explore such a wide belt of country, use must be made of all existing maps. These when made from governmental surveys will be found of extreme service as a skeleton on which to build such additional information as may be necessary to complete the study in hand. All streams, summits, passes, etc, within the extreme margin of possible routes should be accurately fixed in plan and elevation. A knowledge of the classes of timber, stone, and excavations, and of difficult river crossings, etc., should be included, and from such data, together with closely estimated lengths of lines, ruling grades (obtained from barometer heights), probable traffic, cost of construction, difficulties of maintenance and dangers of future or present competition. A selection is made of the two or three most favorable routes, over which it is thought necessary to make instrumental surveys.

In carrying out reconnaissance, the instruments required will depend on the class of work to be done. These should always include an aneroid barometer, a Locke level, a pocket or prismatic compass and a field glass; distances may be determined from maps, if existing, by pacing, by the rate of travel of a horse, or if in open country, it will be better to take the time to determine them by stadia or some form of telemeter. The aneroid barometer is an instrument supposably compensated for temperature, and under static air pressures capable of always reading the same at the same altitude; but errors in graduation, in workmanship and adjustment, and the barometric changes going on in the atmosphere make it far from a precise instrument. In order to make it available, each instrument when purchased should be rated alongside a mercury barometer, and only those

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

which have a reasonably uniform and small rate of error should be accepted, so that a table of such errors can be prepared and used in conjunction with actual readings taken. Aneroids in high altitudes are often much in error, and generally speaking, should be used to obtain *differences* in elevation rather than actual ones. If a barometer is read at the same spot every hour for a day, a continual fluctuation will be noticed, even during bright dry weather and very much more so during periods of storm or change; these readings if plotted may be termed the *diurnal gradient*. It is evident, therefore, that readings from an aneroid taken at various places, at different times, even during the same day, will not be reliable, and in order to make such readings of value, there should be another stationary aneroid read at regular intervals, and the readings of the moving aneroids corrected according to the fluctuations observed at the central point. Should only one aneroid be available, it would be better, where possible, to make two or more determinations of the same points at different times, to get an average, and to work only when the atmosphere is in a settled condition. Equipped with the above-mentioned instruments and one or two assistants, the engineer on reconnaissance should go into the field free from prejudice; the well-known wagon road or trail may be very convenient to travel along, but not necessarily in the vicinity of the best railway location; the river flowing between or in direction of the termini may have precipitous, treacherous banks, be crooked in alignment, and afford not nearly so feasible a route as the upland country adjacent; just beyond a certain forbidding range of hills may lie a direct and cheap route, and a pass through the barrier may really exist, being hid in the distance by an overlap. In fact, the frame of mind suitable for such an undertaking should be optimistic, ready to believe that if only time enough is available, the best route can be found, but at each moment doubting that such a route is yet discovered.

In addition to those general economic considerations which have been touched on in previous chapters, it is well to remember, amongst other things,

(*a*) That lines following large streams will usually require heavy bridge work and masonry in crossing tributaries.

(*b*) That one bank of a river may be much better than the other, and that it may even pay to cross the river at rare intervals to secure alternately favorable stretches of construction.

(*c*) That lines on side hills are more costly to maintain than those through level country, owing to the sliding and washing that takes place.

(*d*) On the other hand, that a cross-country line, usually, will cross many summits, and even when skilfully located, and often at a considerable loss in distance, will abound in curvature and maximum grades.

(*e*) That in each locality will be met men who have an intimate knowledge of the minutiæ of the surrounding country. Many of these look on themselves as born locating engineers, and while their ideas on grades and curves are usually misty, every shrewd engineer will not be averse to the valuable aid which such men voluntarily offer; the only difficulty lies in sifting the wheat from the chaff without giving personal offense.

(*f*) That the engineer of reconnaissance and afterwards of surveys is the first officer of the railway company to be thrown in contact with the people who are to become the future patrons of the road, and, as such, his manifest duty is to make as many friends for his company as he can, consistently with his other duties, and enlist their sympathies in its favor; in this way a much more reasonable spirit will be created which will display itself when right-of-way questions begin to arise.

After a complete study of the intervening country has taken place, a rough sketch map should be made from the notes taken, and other existing ones, on which will be shown the positions of all streams, summits, etc., with elevations marked at critical points, then possible routes will be indicated, calculations made of the length of lines, maximum grades, probable amounts of curvature, approximate cost of constructions, present and future traffics, etc., all of which, although much in error, will usually narrow down the question to two or three routes which are selected as the most likely and suitable ones for instrumental surveys.

Article 13.—Preliminary or Trial Line Surveys.

The roughest class of preliminary survey may be an amplification of reconnaissance, in which a small party of three or four men pass rapidly over several proposed routes at a rate of five to fifteen miles per day to determine what grades can be obtained before more accurate survey begins. In open country rapid progress can be made, using stadia for distances and using vertical angles for elevation or depression, which are checked by an aneroid barometer. In a wooded country the distances will be determined more rapidly by chain and compass, and heights by aneroid. Side slopes may be noted at difficult spots by some form of clinometer. What is usually wanted is to know what grades can be obtained at certain critical points, in order to adopt a ruling grade for the route. The instruments required are a light transit with stadia hairs, compass and vertical arc, a stadia rod, an aneroid barometer, a clinometer, a 100 ft. steel chain and 50 ft. linen tape. On this class of work the error of stadia measurement should not be more than 1 in 1,000, which is more accurate than rough chaining. When a full survey party for instrumental work is to be equipped, a variety of causes tend to determine the men and instruments required.

(*a*) In an open rolling country. If contour lines are not needed, the party will usually consist of—

Chief of party,
Transitman,
Leveller. } Engineers, preferably all experienced.

Rodman,
Front Picketman,
2 Chainmen. } Active young men, preferably educated college graduates, not afraid of work.

2 Axemen,
1 Stakeman. } Seasoned workingmen, used to bush life, axes, and hard work.

If under canvas, add one cook and one assistant cook, and in this kind of country always use a transit.

(*b*) In thickly wooded country, without iron ore, better results, for the same labor, will be obtained by using a 12-inch to 16-inch compass, instead of a transit, avoiding many detentions, useless cutting of trees, etc. The compass has no cumulative error, and will give good results where no contours are taken; if contours are to be taken, it is better to establish transit line for future use. In a wooded country two or three extra axemen will be needed to make rapid headway; the front picketman also, in this case, should be an expert axeman, and lead the others.

(*c*) If the country is much on side-hill, another party is needed in addition to the transit and level parties, whose duty it is to take contours. In the past contouring has often been omitted, and although there have been some men of great natural talent and long experience who have been able to locate well, even through very rough side-hill country, by eye alone, yet even to such men a properly conducted contour survey would have been of great advan-

tage. It is becoming more fully realized every day that a contour map, with a location line laid on it in the office and revised afterwards, where necessary, in the field, is a very valuable part of preliminary surveys in such a kind of country. This topography party consists of two or three men, equipped with a level board, level rod and hand level, or else with a clinometer and tape to measure side slopes; the work is carried on one day behind the level party, and the method of procedure is somewhat thus:

Detached sheets of paper about 18 inches by 24 inches, have plotted on them the centre line and level height at each 100 feet and hub, according to the previous day's records; these sheets are mounted on a drawing board and taken into the fields, where 5 feet or 10 feet contours are plotted and sketched direct, for a distance of 20 to 50 feet in elevation, up and down hill from the centre line, depending on evident requirements; with a little practice, the distance to each contour can be taken and plotted very rapidly, obviating the necessity of notes. Intermediate irregularities, etc., can be also sketched in by eye, and the sheets when taken back to the office can be placed in proper alignment and chainage, and a tracing taken if necessary; but probably the projected location line will be at once placed on these sheets and then transferred to the field at once, or by another party following, or the whole matter may be held over until a decision is arrived at as to the correct location route to adopt; this will evidently vary with each case. If the contour notes are recorded in books in the field, they may be plotted on a continuous roll in the office; but such a method is more tedious, and little irregularities which would be sketched in the field are often omitted in notes. A topography party relieves the transitman of all note-taking except centre alignment, whereas all notes of natural and artificial topography are taken by the transitman where no topography party is employed, thereby delaying the progress of the whole survey. A topographer should preferably be a Provincial Land Surveyor also, so that his work in recording land lines and making plans may at once be legalized.

The qualifications and duties of the members of a survey party are somewhat as follows:

The Chief of Party should be a man of vigorous mental and physical attainments, familiar with the details of survey life and minutiæ, with a wide experience of construction, and even, if possible, of maintenance of railways, well informed on such matters as have been touched on in previous chapters, and capable of commanding prompt obedience and zealous assistance on the part of every member of the party. If, in addition, a man can be found who has also a natural genius for railway location, he cannot be too highly treasured or paid. The chief of a survey party is the most important position in the pay of a railway company where location is of a difficult and perplexing nature. Crippled constitutions and receiverships are more often the result of poor location than from any other cause, hence the high value of the men who decide on such matters. A chief may be a strict disciplinarian and still command the regard of his assistants; he should have free scope to dismiss anyone not competent and willing to do good work; and should never do any work for subordinates, except in the rarest instance, but should be well on at the front most of the time, devising the next step before it is needed, and having in view a general plan of the country, not looking straight ahead, but feeling that just "beyond" there may be a better line. The rate of progress is fixed by those at the front, the others must keep up. A chief of party carries usually a pocket note book, or even topography book, an aneroid barometer and a pocket compass.

The Transitman should be an engineer of some experience, particularly in handling men, keeping full and accurate notes, and rapid and yet delicate handling of his transit. He should be alive to the general movement of the men in his party, which means that he should not always be looking through his telescope at them, but commanding their movements directly also, and above all, he should put his transit in position quickly, and not keep a whole party waiting while he dawdles over his levelling screws, etc. Where there is no topographer, the transitman, in addition to keeping notes of the survey alignment, must sketch neatly, with necessary measurements, all buildings, roads, farm lines, etc., in fact all artificial and natural topography, and obtain all owners' and tenants' names. In a level country, topography should extend for at least 500 to 1,000 feet on each side of the line, as the location may be moved that much, and thereby run through houses and barns that have not been noted. This should be done where necessary by accurate chainage offsets. In country of steep side inclinations this is not necessary; judgment will determine the width of the topography belt needed in each instance.

The Leveller may be a young engineer of limited experience, although preferably one capable of rising rapidly to higher position, and not one whose engineering horizon is bounded by such work. In addition to centre line levels, taken at each 100 feet station, hub, and intermediate change of vertical direction, the leveller notes the wooded and cleared portions, the class of timber, probable nature of material in cuttings and borrows; the depth, volume of flow and high water mark of all streams, and establishes bench marks, at say each half mile on preliminary surveys.

The Level Rodman and Chainmen should not only be instructed how to do their work, but day after day should be made to chain and hold their rods correctly; chains should be tested frequently. It is certain that more errors are due to poor chaining and rodding, to insecure hubs, and to slovenly work amongst subordinates generally, than to poor instrumental work, although the blame for such errors is usually laid on the latter.

A Front Picketman is invaluable and should be distinct from the chainmen; he should be an active, intelligent man, one who can select a transit site with judgment, make and drive a hub well, take centre, make and drive reference stakes, make a cross-head for back-sight, and then, after placing his picket *exactly* on line, or laying it on the ground, continue to make stakes until the transitman arrives, or better still, if so directed, he may continue to the next site and be ready by the time the transit is placed, to take hub again. In cleared country, hubs should be driven in secluded spots along fence lines, etc., wherever possible, or else in a few months all traces of line across cultivated fields will be obliterated. If hubs come, necessarily, in open places, extra ones should be put in in sheltered spots. If the line is being carried through forest, the same care will not be necessary to preserve the line, and transit sites will depend more on natural profile: in this case the front picketman should be continually taking line for clearing, and leading, and commanding the axemen, being himself also, for the time, an axeman. In general, it is best to not have a back picketman; but have the transitman place a cross-head on line within a few inches of his transit telescope just before moving forward. If a back picketman is employed, it is best to still use a cross-head and keep the man merely as a guard and

handyman for occasional use in emergencies ; a cross-head is very accurate and never falls asleep at inopportune moments.

During survey, people naturally resent injury to crops and premises, even when the least possible is inflicted, and polite words and sincere endeavors to minimize the loss are rightful and expedient. Many survey parties constitute themselves armies of invasion ; trees are needlessly cut down, growing grain trampled on, fences torn down to make stakes, and a general tone of overruling ruthless power is prevalent, all of which is wrong and foolish. Many life-long enemies to the road have been made in just this way, and the probable immediate consequences will be that all stakes will be torn up and thrown aside as soon as the party has passed by, and, in addition, the purchase of right of way will be made needlessly difficult and expensive ; the far-reaching consequences to a railway company of the actions of survey parties in this respect are beyond calculation.

After preliminary surveys are completed, and it is desired to obtain approximate estimates of the quantities and cost of construction for a comparison of routes, various short-cuts are used. Excavation tables can be purchased or made for taking out quantities of earthwork. General plans of trestles, culverts, etc., can be used, and tables drawn up of the cost per lineal foot for various sizes and heights, but the larger structures will each require special calculations. In taking out approximate quantities, remember—

(*a*) That embankments require more than cross-section measurements indicate, by about 5 per cent. if of sand, 10 to 12 per cent. if of clay, and 15 to 25 per cent. if of loam or peat, but that rock expands 25 to 75 per cent., depending on the size of the rocks. This shrinkage will not take place fully for a year or two, and may not exist at all during hurried construction, and will be made up afterwards by train.

(*b*) That unless the depths of foundations are known, a liberal allowance should be made for possible deep ones.

(*c*) That side-hill quantities are not indicated by the centre line profile and should be specially provided for.

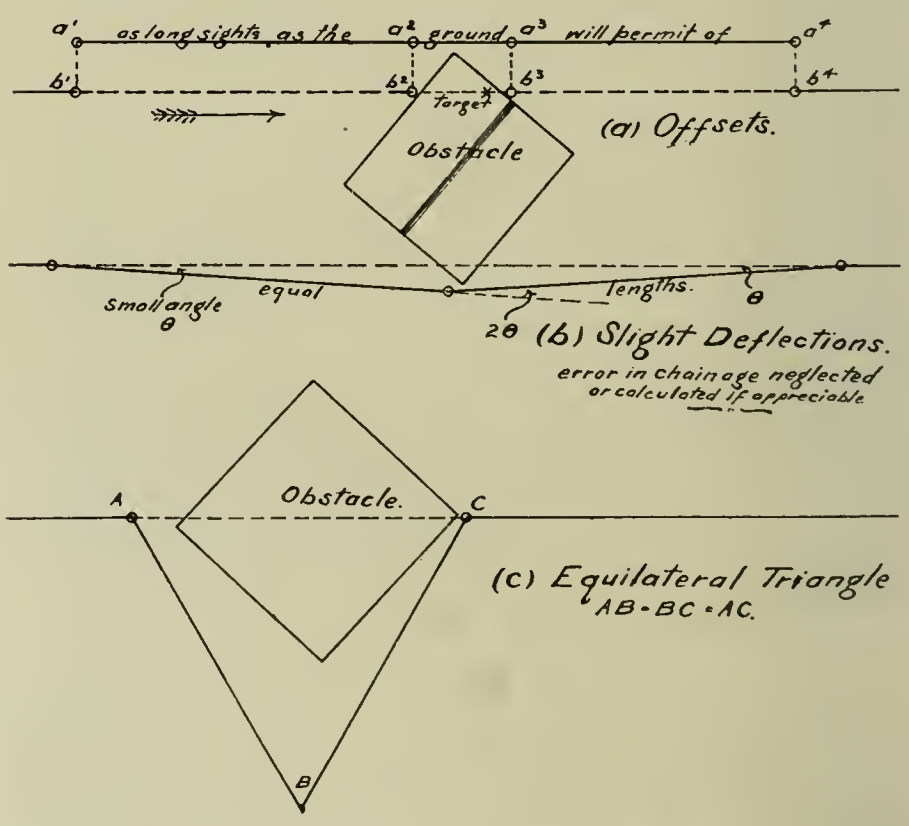
(*d*) That the classification of material is likely to be higher than surface indications would seem to warrant.

Article 14.—Location Surveys.

The duties of each engineer of a survey party are considerably increased when the location of the selected preliminary line is decided on. The chief and transitman note the foundations for all structures, and should be given time and facilities to have soundings of the beds of the streams, etc., made, so as to determine the depth of foundations quite accurately. This may be made a part of the leveller's duties, if he has more time for it. They should carefully note the natural resources of the country passed through, whether good quarries and ballast pits exist or not; whether timber suitable for trestles, piles, or ties is available, and the probable traffic on various intersecting highways, so as to determine at each one whether it will justify the company in expenditure sufficient to pass the road over or under the railway. In fact every item of information necessary for a complete knowledge of each structure, etc., so as to be able to say definitely what structure is best at each point and why. If the topographer is not a land surveyor it will now be necessary to add one to the party, whose duty it will be to fix the exact position and angle of crossing of each property line, and measurements to nearest monuments, the bearings being taken by compass. Also to obtain the full names of all owners and tenants whose properties are to be affected, the exact positions of all buildings or highways within 400 or 500 feet of the centre line, and all prominent natural topography. The leveller, in addition to those duties already noted for preliminary work, will need to establish and witness bench marks about every 1,000 feet not closer than 30 feet or 40 feet to the centre line, nor more than 50 feet or 55 feet in a bush country, while in an open country any convenient distance laterally will answer. Very few places should be deemed suitable for a bench mark ; the root of a large green stump, or the top of a small one, cut off for the purpose, is the best. If the root of a tree is used it will grow a little in the course of years ; it is liable to be invalidated by the wind blowing the tree over, or lifting the roots in loose soils, and worst of all, if on the right of way it is liable to be burnt up or cut down below the blaze made on the side of the trunk for reference, thereby being lost entirely. Bench marks should be selected at elevations close to structures, but otherwise at heights nearly that of the proposed grade line, so as to be convenient in running grades, ballast heights, etc. When a located line is laid down without much revision, it will, in any difficult

Fig. 19.

Methods of producing a straight line past an obstacle



country, pay by many times the expenses of a survey party, to revise the whole line, when numerous small changes will be made from point to point.

In finally staking such a revised line, it should be thoroughly done, and hubs and stakes stout and well driven, good strong nails (1-inch tinned) used. No hub should project more than half an inch above the ground, and in a settled country stakes should be bought at a sawmill and carried along a day at a time ; the using of fence rails for stake material creates more ill-feeling than the trifling economy warrants. Unless construction is imminent, all hubs should be referenced by cross lines or otherwise. Nothing is much more disheartening to the constructing engineer than to find a located line almost obliterated and untraceable. There are three general methods of prolonging a straight line beyond an obstacle.

(*a*) By offsets, where the necessary offset is not very long; this is the most accurate method. The measurements a_1b_1, a_2b_2, a_3b_3, a_4b_4 are identical and made very carefully with a steel tape and plumb line ; the transit sites would be at b^1, a^2, b^4, with a target placed on top of the obstacle, if possible, as a back sight check. (See fig. 19.

(*b*) By making a slight angular deflection measuring a certain distance until just opposite the obstacle, then deflecting back twice, the first deflection measuring an equal distance and then deflecting again on to tangent, by an angle equal in amount and direction to the first one, the error in chainage is usually disregarded; this method introduces three angular measurements and is not likely to give an exactly straight line for this reason. (See fig. 19.)

(*c*) By laying out an equilateral triangle, this fixes the chainage beyond the obstacle, and presumably the direction and line; but as this method introduces three angular measurements and two linear ones, it is not apt to give as good results as the first two. (See fig. 19.) It is understood that if by placing a transit on top of a secure obstacle the line can be prolonged directly over it, it is best to do so even at considerable personal inconvenience.

If very accurate transit work is desired, it is not best to trust to the adjustment of the instrument, but take two points on each hub, and use the mean. In the same way, equal backsights and foresights in levelling should be obtained wherever possible, to minimize the result of a level being out of adjustment, and also it is best to adjust instruments for about the distance that the ordinary sights are to be in any given class of country. The travel of the tube in a large change of focus often throws an instrument out of adjustment for very short or very long sights.

It is often found that a survey party, before being disbanded, has time to do cross-sectioning for construction; this is a mistaken economy, and a source of errors and mutual accusations. The members of a survey party do not take interest in work; they are not to superintend, and the cross-sections will probably be poorly chosen and executed. Then the centre line will very likely be altered in various places, which will invalidate all sections at those points. Generally speaking, it is best to have the engineer of construction do everything of an engineering nature which appertains directly to his work.

(*To be continued..*)

THE PETROLEA WATER WORKS.

In January, 1893, the town of Petrolea, Ont., made an agreement with the Petrolea Waterworks Company to lay about 40,000 feet of pipe, with 70 hydrants. The water was to be taken from wells in the gravel beds in the townships of Enniskillen or Plympton. In August, 1894, an extension of time was granted to the company, which had then laid only about two miles of piping. In 1895, the company having failed to carry out its agreement, owing to the difficulty in finding a well with a sufficient yield of water, the corporation began operations on its own account by sinking a test well about 4½ miles east of the town, which yielded 70,000 gallons per day, but which was not found to be permanent.

At this point Willis Chipman, C.E., Toronto, was engaged to report on the whole question of water supply. In his first report, August 27th, 1895, four sources of water supply were discussed, of which the River St. Clair and Lake Huron were found to be the best. A second report was presented to the town council by Mr. Chipman, which discussed the Lake Huron scheme. The plan here discussed was adopted by the council, upon the following estimates submitted by the engineer:

Pumping station at Lake Huron, including pump house machinery, intake detached residence for engineer	$ 15,000
Force main, including right of way and damage.....	103,000
Distributing system in town, including a sum to purchase the mains already laid by the company.....	35,000
Standpipe	8,500
Meters	3,000
Engineering and contingencies	7,000
	$171,500

The late Alan Macdougall, C.E., made a report upon the plans prepared by Mr. Chipman, in which he suggested a filter bed in the lake, protected by crib work, and having an area of 7,500 square feet. E. H. Keating, C.E., city engineer of Toronto, was asked to pass upon both schemes. He was in favor of an enlarged conduit pipe and intake, and other alterations which increased the estimate by about $50,000. The town council decided to proceed with the work as planned by Mr. Chipman in his report originally adopted. Work was commenced April 1st, 1896, with Mr. Chipman as engineer in charge.

During April and May the conduit line was located and staked out, the point of intake and site for building selected, and plans and specifications prepared. During this time the right of way for the conduit was secured by the committee. The contract for the whole work except machinery was let to W. Garson & Co., St. Catharines, Ont., for $131,945. The contract for the machinery and boilers was let to the Hughes Steam Pump Co., of Cleveland, Ohio, for $14,289.

The intake pipe is 1,089 feet long from the well to the strainer, and 12 inches in diameter. The depth of water at the outer end is 15 feet, with the lake at 580 feet above the sea level. The intake is so designed that it can at any time be tested for leakage, or flushed out from the pump room. At the outer end is placed a cylindrical crib, or strainer, of ¼ inch boiler plate, 4 feet in diameter and 5 feet high, the upper part being perforated with ½ inch holes, spaced 1½ inches centre to centre. The top of the strainer is about 10 feet below the lake surface. It is protected by ten twelve-inch piles. The intake pipe was completed and lowered to grade in April, 1897. Considerable difficulty had been experienced in laying the intake pipe, as a sand bar 150 feet from the shore refilled the trench, which was dredged for the pipe several times.

The pipe also parted on a couple of occasions. Upon subjecting the pipe to a test pressure of 20 lbs. to the square inch, a leakage of 25 gallons per minute was determined. It was discovered that the strainer had lost its upright position owing to the sandy clay washing out from one side. It was righted by dredging under the other side, and was then connected with the wooden piles, which surround it by a heavy iron chain. It is the opinion of the engineer that the strainer will eventually have to be protected against accident by a stone filled cribwork. ×

The pump well is circular, with an interior diameter of 14 feet, and a depth of 12 feet below the surface of the lake when it is at 580. The floor level of the engine-room is 6 feet above this lake level, and 11 feet below the ground surface. The material passed through in excavating for the well below the floor level of the engine-room, was entirely a blue clay through which no water whatever percolated from the lake. The walls of the well are of hard brick laid in Portland cement. The top of the intake where it enters the well is at elevation 576, thus giving about four feet of head in the pipe with the present lake level. By an arrangement of pipes and valves in the well, water can be pumped directly through the intake, and water can be turned back through the intake by an 8-inch connecting pipe from the discharge main. The lower four feet of the well cannot be pumped out by the main engines, this space being left for sediment to collect, but it can be pumped out at any time through a flexible iron section pipe by boiler feed pump. The well is entirely outside the building, and is covered.

The pump-house is located on the northeast corner of lot 9, 8th concession of the township of Sarnia. It is a white brick building 30 x 100 feet, divided into engine-

room, boiler-room and coal shed. The smoke stack is of brick, 73 feet high, 8 feet square at the base, with a flue 30 inches square. Near the pump-house a two story brick house for the engineer was built.

From the pump-house to the town limits of Petrolea, the conduit line is of cast iron pipes 12 inches in diameter. The length of the line is 57,943 feet, but the 12-inch main continues 3,705 feet to the water tower, and 4,502 feet to Petrolea street, the whole distance being nearly 12 miles. All the pipes are laid to grade, most of the line having an inclination of one in 1,000 only. On the line are seven gate valves, four automatic air valves, and four blow-off valves.

The pipe was supplied by the Gartshore-Thompson Pipe Foundry Co., Hamilton, except about 15,300 feet, which was supplied by the St. Lawrence Foundry Co., of Toronto. Several weights of pipes were used, the heaviest being at the north end. The conduit line was tested by maintaining the pressure of 200 lbs. to the square inch at the pump-house, for six consecutive hours. Very few leaks were discovered, and only three pipes failed in the preliminary tests made by the contractor. This pressure of 200 lbs. at the pumping station gives 147 lbs. at the height of land, and from 160 to 180 lbs. in the town. This is the longest waterworks conduit in Ontario, working under pressure.

The distribution pipes were laid with four feet six inches of covering, and generally in stiff, blue clay. The valves were manufactured by the Doherty Manufacturing Co., of Sarnia, and the hydrants by the Kerr Engine Co., of Walkerville. The hydrants have five-inch barrels, and are provided with a four-inch steamer nozzle, in addition to the two ordinary hose nozzles. The valve chambers are of hard brick laid in cement with heavy cast-iron manhole covers.

All valves are provided with extension spindles. Gate valves with valve boxes were placed on all the hydrant branches on the 12-inch mains, in order to permit the repairing of these hydrants without closing the valves on the 12-inch main. Two three-inch relief valves were placed on the system at a very low point where the pressure is greatest, also two of the same size under the water tower. These valves are set to relieve the mains when the pressure exceeds 120 lbs. The total length of pipe in conduit and distribution system is nearly 22 miles.

The water tower is of steel, 25 feet in diameter and 85 feet high. It rests upon a foundation of very heavy stone masonry laid in Portland cement mortar. The cylinder is well anchored to the masonry and has an ornamental balcony at the top, reached by a ladder. The tower contains about 257,700 Imperial gallons, or approximately 3,000 gallons per foot in height of the tower; when full it will give a pressure at the fire hydrants varying from 25 lbs. to 50 lbs., the average being about 30 lbs. To give domestic pressure in town, it will be necessary to keep the tower half filled at all times. The water in the lower half will be available for fire supply, but not for domestic purposes. By cutting off the tower, a good fire pressure can be given direct by pumping from the lake.

There are two pumping engines, one a compound "Duplex," and the other a compound "High Duty Fly Wheel." The first was manufactured by the Hughes Steam Pump Co., the second by the London Machine Tool Co., of London, Ontario. The duplex has steam cylinders, 14 inches and 26 inches in diameter, plungers 10 inches diameter, all with 18-inch stroke. The high duty engine has steam cylinders 13 inches and 26 inches diameter, water plungers 6½ inches diameter, with 32-inch stroke. It is speeded to make about 50 revolutions per minute. This engine is a very compact machine, the fly-wheel revolving on a shaft placed near the steam end. Each of these pumps has an easy capacity of 700 Imperial gallons per minute, or one million gallons per twenty-four hours, against a head of 200 lbs. to the square inch. One independent fly-wheel air pump, with feed pump attached, is operated in conjunction with a surface condenser, placed on the discharge main. A duplex feed pump supplies the water to the boilers. This pump can be used to empty the well, to pump into the conduit, or for hose service at the pumping station. Three 3-inch relief valves are placed in the engine room, with ample discharge pipes. Steam is supplied by two return tubular boilers 16 feet long, 62 inches in diameter each, with 68 tubes 3½ inches in diameter. These boilers were made and set by the Stevenson Boiler Works of Petrolea. Although both engines were in running order on January 1st, 1897, the contractors for machinery were not ready to test the pumping engines until February. The first test was made on February 4th and 5th, J. H. Killey, Esq., of Hamilton, representing the pump manufacturers. The fly-wheel pump was run ten consecutive hours under 200 lbs. water pressure, at the rate of 1,000,000 gallons per 24 hours, the coal consumption being 2,300 lbs. The duplex, in 10 hours, under the same pressure, and pumping at the same rate, consumed 4,400 lbs. This test gave a duty considerably below that guaranteed for the fly-wheel pump, but the duplex exceeded the guaranteed duty. On March 18th and 19th a second duty test was made of the fly-wheel engine in the presence of the manufacturers. During ten hours the coal consumed was 2,430 lbs.; ashes removed, 121 lbs.; water pumped, 462,338 imperial gallons; water pressure, 200 lbs.; suction lift, 14 feet; temperature of feed water, 109 F. The duty determined from the above is 98,570,000 foot lbs. per 100 lbs. of coal. The duty of the duplex engine was found to be 55,000,000 foot lbs.

The only defect in the Petrolea water supply system is that the pressure is not sufficient for fire protection. The town has, however, two fire engines, and all hydrants are provided with steamer nozzles. The engineer recommends that when the amount to be pumped daily increases to over 500,000 gallons, a pumping station should be erected near the water-tower, to be provided with two underwriter fire pumps of the same capacity as those at the lake pumping station. In this way water could be pumped out of the tower or the conduit line, and forced into the system under any pressure desired.

The quantity of water available is about 1,000,000 gallons per twenty-four hours. This quantity of water would supply a population of 10,000 people, allowing 100 gallons per day for each person. This is the quantity pumped in London, Brockville and Toronto, but less than that pumped in Sarnia, Port Huron, Windsor, Detroit, Cleveland, Buffalo and other lake cities and towns.

In spite of the recommendations of the engineer, that meters should be placed on all the services, they were only placed upon the services of the large consumers. As the original plans of the system were prepared with the idea of using meters all round, it will probably not be found adequate if the small consumers are allowed to waste the water. This matter, however, can probably be adjusted when the difficulty arises.

THE Farmers' Hedge and Wire Fence Company of Ottawa, Limited, has received an Ontario charter. Capital, $25,000. The incorporators are: J. Bright, Myrtle, Ont.; J. Vipond, Brooklin, Ont.; R. R. Mowbray, Kinsale, Ont.; E. E. Cooper, East Whitby, Ont.; J. D. Howden, Whitby, Ont.

THE GREAT LAKES AS A SENSITIVE BAROMETER.

BY F. NAPIER DENISON, METEOROLOGICAL SERVICE OF CANADA.

Concluded from last issue.

From a careful study of the subject, with the assistance of the foregoing tabulations and records, the following points have been deduced:

(1) That when the lake record is least disturbed, so is the barometric trace.

(2) When the lake undulations become large and rapid, so do the atmospheric waves as recorded upon the barograph.

(3) There is a marked correspondence between the time intervals of these undulations as recorded by both instruments, the larger waves averaging 20 minutes, and the smaller ones 10 minutes.

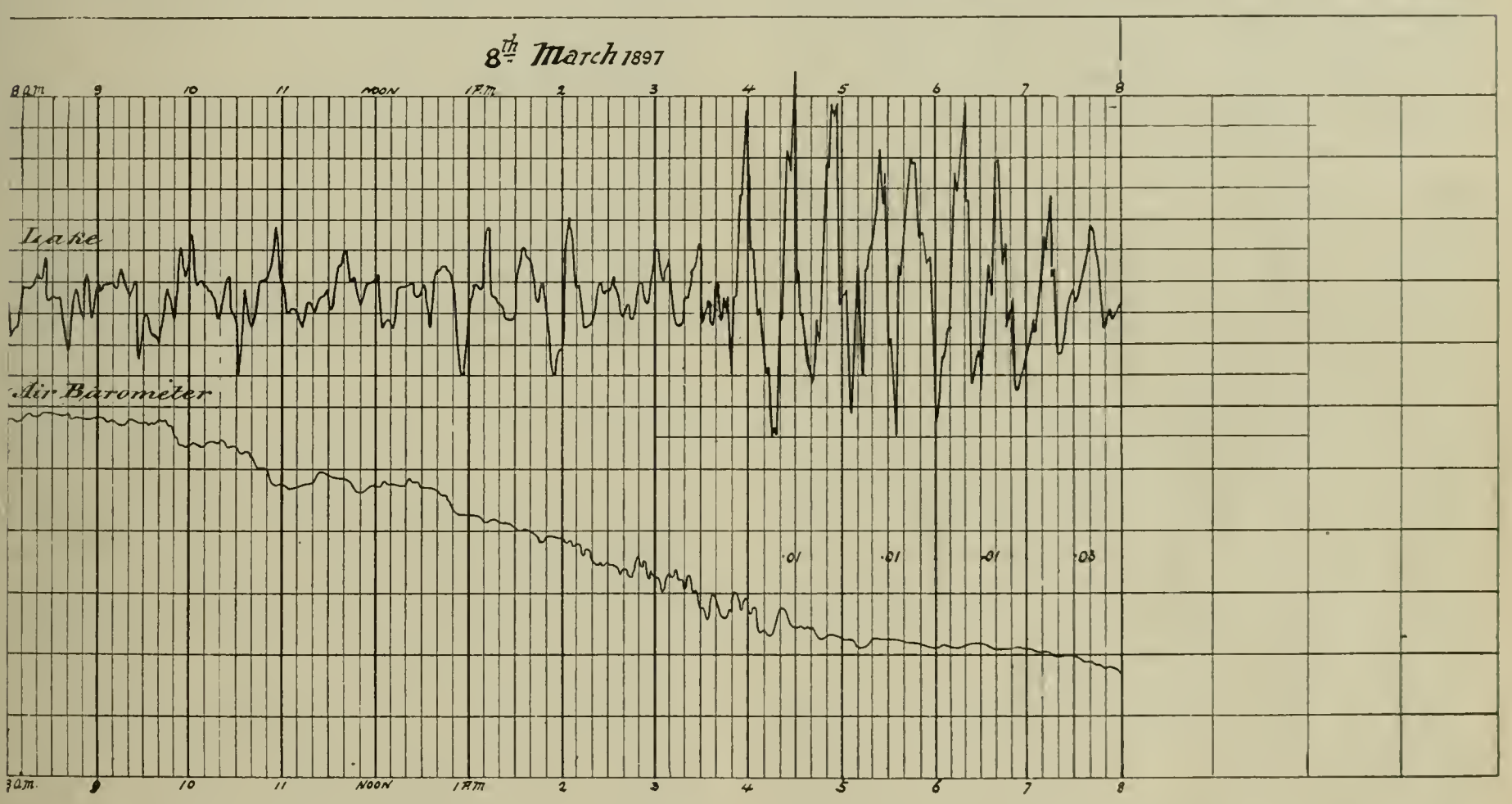
(4) That the lake level is never stationary; the smallest movements recorded for twelve consecutive hours was ½ to 1 inch, when the barograph trace was also very quiet.

(5) That the longitudinal and transverse "seiches" are due to great differences of atmospheric pressure between the extremities of the lake, which are doubtless augmented when the gale strikes the water's surface. These "seiches" consequently appear shortly before, during, and for several days after the passage of some severe storms. The lake trace before us clearly shows this movement, and the following chart the position of the barometric gradient at the time of this record. From a limited number of observations the time interval of these "seiches" appears to be four hours and 49 minutes, and 45 minutes respectively. Should the isobars lie parallel with the length of the lake during the passage of a storm, the "seiche" movements become almost imperceptible. (The quiet traces of both barograph and lake instrument for the 27th February last, bear this out). This may explain why little or no undulations were remarked by Professor Forel, upon the Swiss Lakes, on certain days, although the wind was strong.

(6) The rapid heaping up of the water at one end of the lake, which is also due to great differences of atmospheric pressure between its extremities, in conjunction with the action of the wind, sets up powerful currents at both top and bottom of our lakes, which although of great sanitary benefit, particularly to the fish, cause much inconvenience and often loss of property to the fishermen; for after such disturbances, their nets, if set at right angles to the length of the lake, often drag their anchors some distance, and when brought to the surface are found to be filled with debris from the bottom of the lake. Such rapid changes of water level are invariably followed by the "seiches" or movements of oscillation of the whole lake's surface.

(7) That the smaller undulations are due to the direct action of the atmospheric waves or billows as they move over the surface of the lake, tending to form minute undulations upon the surface, corresponding in length to these billows, and as they move further into the bay, becoming magnified as they reach narrower and shallower portions, until finally they assume the proportions recorded upon the instrument.

(8) That these lake undulations become rapid and of great amplitude during fine weather, and a rising or stationary barometer when an important anti-cyclone is central over the lake region, and a pronounced cyclonic area is developing over the Southern States. This clearly



demonstrates the existence of great atmospheric waves, set up along the boundary surfaces of the upper and lower strata, caused by the upper portion of the lower air stratum, not being retarded by friction from contact with the earth, and of greater specific gravity than that to the south of it, beginning to move towards the region of lighter air, viz., in a southerly direction. The barometric gradient being small, the movement is slow, but in an opposite direction to the upper stratum, which is less dense and rapidly moving polewards.

(9) The falsely termed "tidal waves" encountered upon the lakes, especially upon Lake Erie, are due to large and rapid atmospheric changes, so often noticeable upon the barograph preceding or during thunderstorm conditions. The above is a fair illustration of the smaller "waves" as shown upon the Humber instrument for the 8th of March last. Here you will observe that both barometric and lake traces are decidedly disturbed until 2.45 p.m., when several abnormal undulations appear upon the barograph, followed shortly afterwards by correspondingly large lake undulations, greatest amplitude 11½ inches in 15 minutes. You will also notice the marked 10 minute intervals be-

tween the smaller waves or "notches," as Professor Darwin would call them, upon the larger undulations. During this day thunderstorms were general near Lake Erie, while in the vicinity of Toronto there were only light showers.

(10) The larger lake undulations may account for the existence of the greater waves so frequently encountered by fishermen and sailors at apparently regular intervals. These are often termed "the three sisters" or "sister waves," as they usually appear in threes, the centre one being the largest. The central wave appears to coincide with the crest of such an undulation.

Before concluding permit me briefly to apply this study to the ocean tidal records as a probable means of accounting for what are termed "secondary undulations." From a careful study of certain St. John, N.B., and Halifax, N.S., tidal curves, furnished through the kindness of W. Bell Dawson, director of our tidal service, in conjunction with the synoptic weather charts, similar results to those upon the lakes were obtained.* These secondary undulations become most pronounced during fine anticyclonic weather, preceding by many hours the advent of approaching storms from the south and south-west. On the other hand the traces become quite quiet when the pressure is increasing to the westward of these stations, which is usually a precursor of fine settled weather.

These undulations are not due to "seiches," or movements of oscillation, which can only apply to enclosed bodies of water, but to the direct action of atmospheric waves or billows. These tend to form minute undulations upon the surface of the water at the entrance to bays, etc., which, as previously stated, become greatly magnified at the narrower and shallower ends of these arms of the sea. These secondary undulations exist throughout the world at all tidal stations, situated as stated above. They are graphically shown upon some of the tidal diagrams which form part of Admiral Wharton's report for the Royal Society upon the "Krakatoa Seismic Sea Waves"; also by Major Baird and others. It is interesting to note the marked regular and continuous undulations at Honolulu, which, if more thoroughly studied, may prove to be due to the influence of the North-east trades.

Finally, permit me to draw a few conclusions in connection with what has been brought before you. Modern meteorologists realize the necessity for a better knowledge of the upper atmosphere as a means of improving our present methods of weather forecasting, and have already done much through the use of kites, balloons, and cloud observations. May we not add the study of atmospheric undulations, as shown upon the lake and sensitive barograph records? The two former means are dependent upon certain atmospheric conditions, while the study of the clouds may often be confined to the lowest stratum, and at other times the sky may be quite clear; whereas the latter can be studied continuously, during all types of weather, by stationary instruments at the bottom of this ocean of air. Since these undulations occur upon all waters, would it not be of great scientific and commercial value not only to increase the number of these instruments upon the great lakes, but in place of eliminating these movements when tabulating ocean tidal records, to magnify their amplitude and study them in conjunction with the corresponding synoptic weather charts? Should the theory upon which the foregoing suggestions are based prove correct, such observations would be especially useful along a western seaboard, such as that of Great Britain, or our own British Columbian coast, indicating the existence or approach of ocean storms many hours previous to a fall in barometer at these stations. In conclusion may we not look forward to a day not far distant, when the ordinary mercurial barometer will be superseded by more sensitive self-recording instruments, and when the study of atmospheric waves will have become universal? Then will the forecast official be supplied, not merely with the actual barometer readings now furnished by the telegraph stations throughout his country, but by a special cypher code, with the undulatory condition of the atmosphere at these stations; and with such an increase of data at his disposal, who can fix a limit to the possibilities of weather prediction in the future?

*A probable solution of the secondary undulations found upon Self-recording Tide Gauges. Proceedings of the Canadian Institute, 1897.

For THE CANADIAN ENGINEER.

THE ADVANTAGES OF THE SEPARATE SEWAGE SYSTEM.

BY W. M. WATSON, TORONTO.

The celebrated scientist, Ward, said that when arranging a system of drains and sewers, the rain water should be conveyed to some stream and the sewage to the soil, and there is sound logic in his remarks. It is of more importance to have two sets of drains, one to carry off sewage only, and another set to carry off rain water and the waters collected from springs and clean land, than many persons appear to suppose. Where the two-set method is installed, it will be found to be of incalculable advantage to the preservation of the public health.

If we take Toronto, which uses the combined system of drainage, for an example, we note that considerable claims are very often put in for damages done to property, on account of sewage and sewage deposits being forced back through the sewers into cellars and basements, and the damage claimed on this account is only a small percentage of the real damage done by the sewage being forced back on to private property during rain storms. Then there are thousands of street gullies, with large bags or pockets, which catch and retain the manurial and vegetable deposits washed off the street, which lie motionless, and by so doing set up fermentation and putrefaction, causing foul, unhealthy smells. These also we find to be periodically emptied of the foul matter right under the nose of the pedestrians. The cost of these trapped gullies when installed, and the periodical cleaning, is a large amount, and is almost sufficient to pay the expense of laying down a simple, shallow and inexpensive system of storm and rain water sewers.

There is nothing in connection with sanitary appliances that can do so much injury to the health of the house occupants as the sewage and the sediment being forced back out of the drain into the basement after putrefaction has set in, and I believe many of the poorest people live unhealthy lives and die of disease because of the practice of mixing sewage and storm water in one sewer.

It is a dangerous practice to put in sewers too large for the ordinary flow, because when that is the case, the flow is indolent and sluggish and moves as it pleases, taking a rest occasionally, and allowing the poisonous solids which it contains to be deposited in the bed of the channel, making the conduit into a settling tank, in fact upsetting every arrangement and duty that the sewers were intended to perform. Water is used to clean and to carry or float away filth or dirt, and it is avoiding its duty if it drops or lets go the solids which it is intended to carry away before the stream reaches the final outfall. The solids which are deposited, silt up the drains, reducing the size; they heat, ferment and putrefy, and manufacture

a dangerous and poisonous gas in large quantities, which is discharged through the ventilation grates, contaminating the atmosphere, and it also presses through the seals of the gully and other traps. If a town's sewers are constructed so as to be capable of handling both sewage and rainstorm water, then they must be 75 per cent. too large for the quantity of straight sewage discharged. The rainstorms will only average about one hour per week, which leaves 167 hours a week for the sewers to act as a chamber for the generating of dangerous gases from putrid matters.

It is impossible to tell what size of drain or conduit will be necessary to cope with the waters discharged by a rainstorm, and if the heaviest rainfalls are provided for by the combined system, large expensive pipes must be laid at a great depth, necessary to collect the domestic sewage and trade refuse as well, while by the separate system large volumes of water which only fall probably six times in a year, could be easily conducted to the proper outfall by surface or shallow inexpensive channels, and by the natural water-courses. On the other hand it is easy to compute the quantity of flow of sewage, for it is very regular and only changes in quantity during the night, Sundays, and holidays ; there is seldom more than 15 gallons of domestic sewage discharged per head per day from water closets, baths, wash basins and sinks. The average trade refuse can be secured by reading the water meters, telling the amount of water used by each manufacturer or firm, and an estimate may be taken of the discharge from public baths, stables, or any other unusual sewage a town may have to handle. Thus a reasonably close figure can be got that will answer to give the size of pipes for each district and the main trunk sewer, and the quantity discharged will usually vary so very little that a small margin only in the size allowed to carry the estimated quantity will be necessary to meet contingencies.

Drains laid down the proper size to carry the necessary quantity of flow will always be self-cleaning, if given a very moderate downward grade, and the sewage passed through them will keep continually on the run, from the moment it enters the drain to the time it reaches the final outfall of the sewer ; therefore the sewage will be delivered at the outfall just as fresh as when it entered the drain, because it is impossible for moving sewage to ferment, decompose, or putrify, and no dangerous gases will be generated. The public will be protected from inhaling sewer gas by the adoption of the separate drain system if properly and intelligently arranged, independent of the traps and ventilating pipes, which are always introduced into good and efficient plumbing. A drain is greatly to be preferred that is continually getting scoured and cleaned by its own flow, than a sewer that is only scoured when a violent rain storm occurs, or when it is artificially flushed by an expensive and often complicated flushing machinery.

But there is a claim for separate drains over and above the before-mentioned advantages, viz., the disposal and the purification of the sewage before being allowed to enter the rivers or fresh water streams, ponds, lakes, etc. It is about as easy and inexpensive to purify a gallon of straight sewage as it is to clarify and purify a gallon of straight sewage adulterated by 75 per cent. of fresh water, and it is obvious that both the first cost of construction and the annual cost of management of any sewage works working under the separate system of drainage, must be considerably less than where the combined system is adopted. On account of the severity of the Canadian climate in winter, and the great heat in summer, water carriage of excrements will be almost in general use throughout the country, and it is the duty of all engineers to see that their bad effects be reduced to a minimum by confining them into as small a space as can be used for their transmission with quickness and safety to the place appointed for their filtration, purification, or discharge on to the land out of harm's way. About the only serious objection to the separate system of sewers is that the soot, dust and manure from the streets is washed into the storm water drains. Now these substances, if allowed to remain motionless after being soaked by water, will ferment and putrify. Should arrangements be made to bring this material into the sewers, then we must accept also the sand, grit and other heavy substances from the surface of the roads, which soon choke up the gullies and channels. To overcome the difficulty of this objectionable matter passing into the surface or rain water sewers, the storm water might be forced through a large settling tank or reservoir immediately before it discharges into the natural watercourse of sufficient size to allow time for the solids to settle. But even if it is allowed to enter the stream without settling, the fluid will be as pure and free from poison as any of the other water flowing into the river from land and stagnant pools. The whole secret of healthy drainage is to keep the dangerous solids and ingredients contained in sewage moving briskly until they can expel with safety to the public health the dangerous gases they contain, and this can only be done by having a separate drain for the conveyance of sewage and trade refuse.

With regard to the expense, I may say that any experienced and intelligent engineer, with a proper amount of foresight, may install a separate system at about the same price as a combined system. Should the geographical position of any town be such that to introduce two separate systems of drains and sewers will increase the cost considerably, the advantages derived from having the two distinct systems to the preservation of the public health is many times more than the extra cost, and is a good return for the money spent. The dirt from the streets should not be allowed to lie in the pockets of the street gully traps. It is a serious menace to the health of the people. The dirt should pass along with the water and be kept in lively motion until it gets clear away from the people and to a place where the filth can be better handled, or where it will be purged of its dangerous elements. By the double or separate system there would be no need of street gullies with traps ; simple grates would answer.

METAL IMPORTS FROM GREAT BRITAIN.

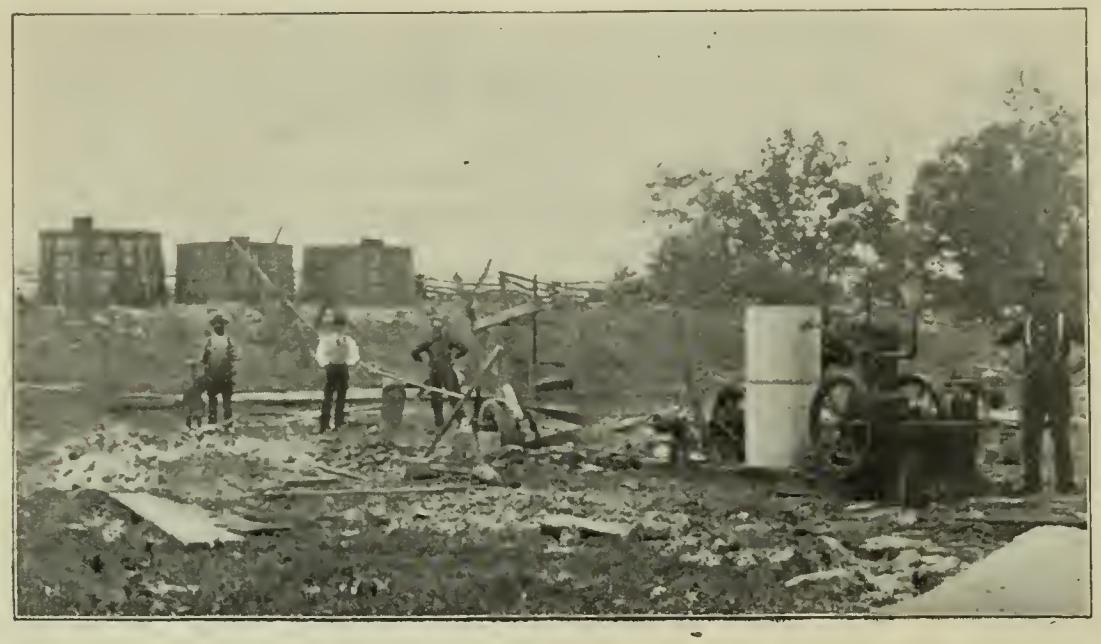
The following are the sterling values of the metal imports from Great Britain during September, 1896, 1897 and the nine months to September, 1896-1897.

	Month of Sept.,		Nine months ending Sept.,	
	1896.	1897.	1896.	1897.
Hardware and cutlery	£6,195	£7,041	£48,867	£50,672
Pig iron	3,838	1,240	21,230	5,298
Bar, etc.	1,101	977	12,626	7,572
Railroad	28,047	171	158,153	38,893
Hoops, sheets, etc.	4,354	13,792	35,758	55,954
Galvanized sheets	5,291	7,346	42,212	35,547
Tin plates	6,401	30 073	91,909	132,849
Cast, wrought, etc., iron	5,103	3,887	40,651	25,957
Old (for re-manufacture)	1,058	1,937	14,862	5,191
Steel	10,519	6,258	73,060	41,061
Lead	1,015	5,170	10,486	19,062
Tin, unwrought	419	2,403	11,716	13,814

THE Bridgewater Power Co., Bridgewater, N S , which is putting in an electric plant, has recently purchased from S. Morgan Smith Co , York, Pa., a 30-inch McCormick turbine, mounted on horizonta shaft.

A NEW OIL FIELD.

An oil well pumping outfit consisting of an "Imperial" gas engine, has been recently installed by the Cooper Machine Company, Limited, Toronto, in the new oil fields near Florence, Ont. This design of engine runs either on natural gas supplied from the well or the gasoline taken direct from the tanks. The illustration shows the entire outfit as arranged with countershafts for connection to the beam of the pump, and the tanks are shown to which the oil is pumped. When first started, the engine ran for some time on the surface flow of natural gas, and as this gave out the gasoline was used instead.



IMPERIAL GAS ENGINE PUMPING OIL WELL, FLORENCE, ONT.

The company is at present making a new design of a pump attachment, in which the slow speed needed for this work is obtained by gearing placed directly on the engine frame, and from which the connection is made without belting. The compactness of this rig recommends itself to interested parties, and the cost of fuel and attention is much less than with steam.

AN AIR SHIP?

Editor CANADIAN ENGINEER.

SIR,—On the evening of September 11th, at about 10 o'clock, or perhaps a little later, the attention of myself and several others was directed to a star of unusual appearance by William Graham, Esq., It had two very beautifully colored lights, red and green, which could be noticed fairly well with the naked eye, but much better with the aid of a telescope. It seemed to be several miles away, and was moving towards the north-west with considerable speed, at an altitude of about twenty degrees when first seen. We supposed the colored lights were attached to a balloon, but this is mere conjecture. May it not have been a party of moonlight excursionists on a trip to the Klondike?

Yours truly,

WILLIAM J. PHOENIX,
Teacher.

Honora, Manitoulin Islands, Oct. 1st, 1897.

AN AIR SHIP?

Editor CANADIAN ENGINEER.

SIR,—In answer to yours of the 22nd Sept., I beg to state when I first detected the light I thought it was the evening star, but it being very large, bright, and more condensed, caused me to observe it carefully, when I noticed it flickering and moving to the north-west. I called the attention of the household and neighbors to look at it. I got the glass, so as to draw it nearer for observation, when I detected the three lights, which seemed to blend through one another, as they were in a straight line from me. I did not see the balloon, it being too far away, and the moon was bright. It must have been about half a mile high, and seemed to keep the same elevation, as far as I observed it. In the distance it looked as if a person was carrying a lantern, as the light kept shading. It must have been the motion of the balloon which caused it. I notice by the clipping you sent me that the balloon was seen at Vancouver on the 13th August, and again on the 16th near Port Arthur, as mentioned in THE CANADIAN ENGINEER for September. Now it appeared here on the 11th September, and again I see by the *World* that it has made its appearance at the north of Russia on the 14th Sept. The wind was blowing here from the south-east when I saw the light, which carried it north-west. The next day it blew from the south-west, which would send the balloon north-east, and the following day it blew from the north-west, which would send it south-east if the wind was blowing from the same direction all over. If it is Andree's balloon, he is, instead of going to the north pole, travelling around the Arctic circle.

Yours truly,

WILLIAM GRAHAM.

We, the undersigned, certify that we saw the light on the 11th September, at about 10.30 o'clock p.m., crossing over to the north shore

ALLAN HOUSTON.
WM. F. GRAHAM,
MRS. WM. GRAHAM.
MISS ELLA GRAHAM.

Honora, Manitoulin Islands, Oct. 1st, 1897.

SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER:

SIR,—I have read with considerable interest Mr. Watson's paper on "Sewage Disposal" in the current number of your excellent journal, but I think Mr. Watson is under some misapprehension as to the action of my filter. The filtrate is never water-logged or immersed in water, as he appears to imagine, as the outlet is always open to the atmosphere, and the sewage to be filtered is held back by the finer surface layer, and passes from it in thin films over the coarser grains of the filtering material below, the interstices of which are kept continually filled with fresh air by means of the blower, which is driven either by power got from the sewage itself, or from the engine pumping the sewage, or mixing chemicals, where such is necessary, or by any other outside power; the power required being extremely small, about 1½ horse-power per million gallons filtered being sufficient.

Yours faithfully,

SIDNEY R. LOWCOCK,
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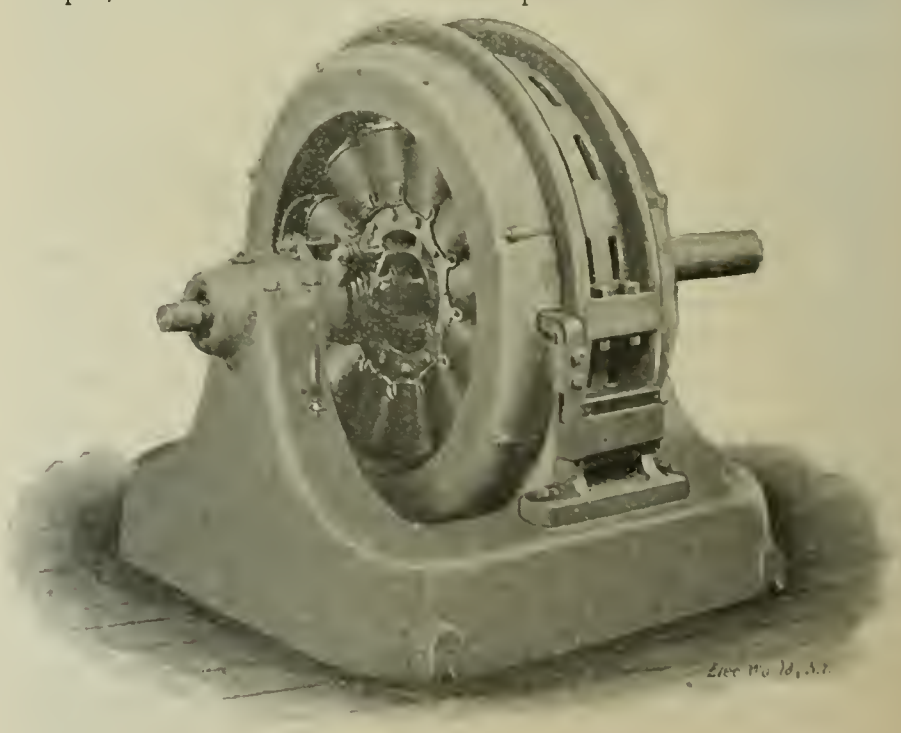
ELECTRICAL MACHINERY AT THE MERRITTON CARBIDE WORKS.

The Willson Carbide Works Company at Merritton, Ont., is probably the only enterprise engaged in the manufacture of carbide of calcium, which is turning out that much discussed product, daily, up to its full capacity, and at a profit. The electrical apparatus used in this plant is of the most interesting character, having been specially designed by the General Electric Company to suit the peculiar conditions under which the manufacture of carbide can be successfully carried on. The company has at present in operation four machines of 150 kilowatts capacity each, and has recently placed an order for two more of the same size, which will be in operation in the course of a couple of months. These generators are of the revolving field type, with stationary armatures, and are designed to run continuously twenty-four hours a day, at a load considerably in excess of the rated output, without a noticeable rise in temperature. The characteristics



REVOLVING FIELD TYPE GENERATOR.

of these machines are such as to enable them to supply a proper amount of current for a furnace at the proper voltage, no matter what the resistance conditions of the arc may be, and they may be short-circuited repeatedly, or even run on a short circuit without injury. The location of two of the power houses renders necessary a transmission at 1,000 volts, and in this case step-down transformers of the Niagara

type are used to reduce the current to the proper voltage for supplying the furnaces. Altogether, the detail and operation of this plant is most interesting, and its success in turning out carbide of calcium on a commercial basis is in marked contrast to the operation of several plants, on a much more ambitious scale, which have been established in the United States.

AMERICAN STREET RAILWAY ASSOCIATION.

The 16th annual convention of the American Street Railway Association opened at Niagara Falls, N.Y., on the 19th ult. The attendance was very large, and the exhibits more numerous than at any previous convention. Among the Canadian members and visitors present were the following: Frederic Nicholls, president Brantford Street Railway, and general manager of the Canadian General Electric Co.; C. F. Armstrong, E. D. McCormick, and Geo. Watts, all of the Can. Gen. Electric Co.; Frank Badger, Montmorency Electric Co.; J. E. Brown, superintendent, and Mr. Bradley, foreman, Hull Electric Railway; W. A. Johnson, of the W. A. Johnson Electric Co., Toronto; Messrs. Griffiths, Wagner, and Fearman, of the Hamilton Electric Ry.; T. Watson, secretary, and C. K. Green, superintendent of the Hamilton Radial Electric Railway Co.; Wilfrid Phillips, manager Niagara Falls Park and River Ry.; Charles James, Storey Motor Co., Hamilton; A. J. Nelles, and Charles Myles, of the Hamilton, Grimsby and Beamsville Electric Ry.; H. Nicholl, of Kingston Electric Ry.; C. E. A. Carr, manager London Electric Ry., and others.

The president, Robt. McCulloch, announced that eleven street railways had sought membership just previous to the meeting. In his opening address the president spoke of the increasing use of Niagara's great power for electrical purposes, among them being important railway extensions. He praised the work of the Street Railway Accountants' Association, which had been formed in connection with the association.

The first paper was by P F. Sullivan, manager of the Lowell and Suburban Railway Co., Lowell, Mass., on "Municipal Ownership of Street Railways." He compared the American system of private company ownership with foreign and American municipal systems, and gave the opinions of prominent men. These opinions went to show that the weakness of municipal ownership was the great corruption that existed in city and town councils. American street railways also had a much greater mileage than European city systems, and the latter also made smaller profits.

In the discussion on this paper, Mr. Bean read a newspaper report stating that the recent convention of Mayors held at Columbus, O., endorsed municipal ownership. He stated that in some States the authorities could take over a road by paying for it, in other States they could not possess it till the franchise expired. In Michigan they had the power to parallel a road and so destroy it.

G. W. Knox, engineer of the Chicago City Ry. Co., read a paper on "Some of the difficulties in the construction and operation of Electric Street Railways." He thought many a road now in the hands of a receiver could be made to pay a dividend, if unnecessary extravagances were cut off. The first thing was to select a staff of operators who were interested in their work, from the head foreman down to the man who swept out the waiting-room. Engines and electrical machinery have reached such a state of efficiency that there is not so much chance of economizing there, but there is great room for saving in the purchase of supplies and the outlay for repairs. The unwary railway man has a great amount of experimental claptrap machinery inflicted on him which is apt to cost him dearly. The competition among makers of electrical machinery has led to the adoption of piece-work in its production, so that it has become cheap, but inefficient. In buying machinery, therefore, detailed specifications should be made out for every piece of apparatus, but to do this requires knowledge and discretion. The stock of supplies should be kept low, so as to avoid loss when new developments require a change of designs. An intelligent staff of motor-men is most important, and a commendable practice is to call the heads of departments together regularly for consultation.

In the afternoon a large number of delegates visited the big power-house, the Carborundum Co.'s works, and the extensive works of the Niagara Falls Power and Manufacturing Co., at which place the chief engineer, W. C. Johnson, gave an instructive account of the power development already accomplished and still to be carried out.

Charles Hewett, electrician of the Union Traction Co., of Philadelphia, read a paper on the "Application of the Storage Battery to Electric Traction." The application of the battery system direct to car or locomotive is more costly, and the expense of operating is greater than the trolley system. It is also less reliable, and is objectionable, owing to the gas given off. Although manufacturers have been working since 1880, they have not surmounted the difficulties caused by the great weight of the storage battery and its rapid deterioration. He was confident that the battery requires more power than a trolley car of same size and under same conditions, and requires a larger investment in machinery. Every battery has what may be termed a critical rate of discharge. From zero up to the critical rate the working E.M.F. remains practically constant, but for any particular battery there remains a rate of discharge which cannot be exceeded without useless waste of energy. As Sir David Salomon observes, "it takes power to get current through the battery, and it takes power to get the current out." These critical rates of charge and discharge appear partly due to the time required for the chemical reactions in the battery to take place. For an electric car the battery needs to have a large output for its weight and bulk. To get this it is necessary to increase the surface of active material and decrease the inactive supporting grid; consequently the apparatus becomes mechanically weak. The difficulty is to get the plates large enough to prevent exceeding the critical discharge rate, and at the same time light enough and small enough to be carried on a car. For the same reasons it is doubtful if the lead battery will ever be successful on a car. Great results are expected from experiments now being made in Chicago, but great results have been expected before, and he did not look for any essential improvement from these experiments. In some cities in Europe there is a proscribed area within which overhead lines are not allowed. To overcome this, the cars are provided with batteries large enough to propel them at a low speed for three or four miles to the point where the overhead line may be used. While the cars are completing the trip the batteries are charged from the overhead wire. This arrangement is only a make-shift, and the fact that the battery is only used on the section where it is compulsory, is of itself a proof that it is not the best. It is also significant that the commission appointed by the larger roads in England and Scotland to investigate the various methods of traction in vogue throughout Europe and America, have vetoed any form of battery car. A third phase of the battery-car system is the battery locomotive. Aside from special forms, such as the Heilman locomotive, the one most worthy of mention is the experiment on the New York Elevated Railway, in which the battery is connected in multiple with the line, and charges or discharges according to the demands of the train. When the demand of the motors is sufficient to lower the pressure on the line to or below that of the battery, the battery will then discharge into the motors, thus relieving the feeders. When current is shut off from the motors, the battery will charge. No results of this experiment have been made public yet, but it is difficult to see how much is to be expected. It has the advantage of maintaining a fairly constant pressure at the motors, but this can be accomplished better in other ways. It subjects the battery to usage which history has proved to be disastrous to its life and efficiency. In this method the extra weight of the battery has the certain advantage of giving additional adhesion to the rails. While not wishing to seem pessimistic, he did not think the outlook for the battery-car was bright, unless some combination of elements be discovered whose characteristics are entirely different from the lead battery. The application of the storage battery to the ends of long lines, was, however, a different matter. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge can be kept well within the limits of normal discharge; and in consequence of this the battery is not subject to the great loss due to the fall of E.M.F. on discharge. Only a few such installations have been made, two of which are on the Isle of Man: one has been installed by the Anaconda Mining Co., at Butte, Mont.; there is also a small plant at Merrill, Wis. The first installation, however, that has been made from any large city road for its suburban service, is the one installed by the Union Traction Company, of Philadelphia, Pa. The increase in the travel necessitated a large increase in the car service and length of line, which was extended to a point 11.2 miles from the power-house. The

drop in pressure over this long line made it impossible to run the requisite number of cars, as the speed of a trolley car is approximately in the direct ratio to the applied E.M.F. The investment in feeders for this line had reached a point considerably above $100,000, not including the conduits. To have increased the cable system so as to have supplied this section properly would have required about 336,000 feet of 1,000,000 circular mils. cable, at a net cost for cables, without conduit, of $273,800, which would have been prohibitory. A station of 750-kw. capacity would have cost about $85 per horse power, or a total of $85,000. A battery station, on the other hand, required but little real estate, and would be inexpensive to operate, and its cost would be considerably less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery, and building, was approximately $25,000; to which must be added the cost of a booster in the main power-house. In this installation, however, they simply adapted a 300-kw. generator to this service, so that they were put to but little extra expense in the power-house for adapting it to booster purposes. If we however, deduct $33,000, the cost of the battery and booster, from $85,000, the cost of a station, the difference in the first cost is $52,000 in favor of the battery. In addition to this, they were put to an expense of a little over $13,000 for changes in the cable. As to cost of operation: During May, 1897, the battery-house delivered to the line 103,053 kw. hours. Estimating the cost of local generation of this power at 1½ cents per kw. hour, and adding interest, depreciation, etc., the cost by local generation method for one month is $2,454. The actual cost by the battery method, including depreciation etc., and central station power at 0.6 cent. per kw. hour was $1,100, showing a saving of $1,300 per month by the use of the battery.

The application of the battery to the power-house has not become very generally appreciated, and but few installations have been made. As its advantages become better known, the practice will become more general. The wide fluctuations in load in railway power-houses are now well known. The average daily load varies from 50 per cent. of the maximum in small stations to 70 per cent. of the maximum in the largest stations. From a very large number of observations in all parts of the country he finds that in the majority of stations the average load is very close to two-thirds of the maximum load. Now, the maximum economy of the steam engine exists for a very small range of load, and on each side of the point of maximum economy the efficiency falls off; rapidly on the overload, somewhat less rapidly on the underload. The result is apparent. In most stations the engines, at the best, have an average load of only two-thirds their most efficient load, and as a consequence consume over 45 pounds of coal per kw. hour. With badly regulated engines, and especially with water-power plants, the changes in load are accompanied by variations in speed, and consequently in voltage. These troubles may be entirely corrected by installing a battery. The battery in this case becomes distinctly a load regulator. In potential regulation a comparatively small battery is necessary, since by changing the potential of booster from time to time during the day the charge and discharge can be kept very low. In the case described, a battery rated at 120 amperes has successfully regulated a total output of 1,400 amperes. For load regulation, however, the battery should have a capacity equal to one-third the maximum output of the station. The average load of the station may then be made the maximum load of the engines, the battery taking care of the fluctuations. As in the previous case, there are no physical limitations to be placed on the size of the plates to be used, and the charge and discharge may be kept well within the normal rate. Under such conditions the efficiency of the battery is high—85 to 90 per cent.—and the deterioration very low. In most cases no additional labor will be required. The writer was of opinion that all small stations could be operated better by batteries.

The next paper was by Maurice Hooper, electrician of the Lynn and Boston Railway, of Lynn, Mass., on "The Use of Multiphase Current Transmission for Ordinary Street Railways," which we hope to refer to later on.

Geo. H. Davis, superintendent of the Canal and Clariborne Railway Co., of New Orleans, read a paper on the "Discipline of Employees," in which he held that both good and bad service should be noticed, the former by a complimentary letter, and at times when traffic is very heavy, the employees should receive a share of the increased earnings. Before any man is discharged he should be given a chance to defend himself. A fixed plan of promotions should be adopted.

A committee was appointed with instructions to draw up next year a code of rules for motormen.

Col. Heft, of the New York, New Haven & Hartford railroad, gave an account of their experiences with the third-rail principle construction. The third-rail system had cost them about $3,000 per mile, or about half the cost of overhead construction.

W. J. Heild read a paper on "The Best Method of Settling Claims for Accidents." A sensible man should be at the head of this department, and injured parties should be examined by the company's surgeon, and offers of assistance made. It was very unwise to antagonize anyone who might bring in a claim for damages. Upon settlement a release in full should be taken before witnesses.

A. E. Lang, of Toledo, O., was elected president; W. Caryl Ely, of Niagara Falls, vice-president; and T. C. Penington, Chicago, secretary-treasurer. Boston was chosen as the next place of meeting.

The Canadian Niagara Falls Park and River Railway, the Great Gorge Route and Frontier Railroad, and the Buffalo Railway Co. gave the delegates the freedom of their roads, which was much appreciated.

KNAPP'S ROLLER BOAT.

Last month the roller boat, designed by F. A. Knapp, and referred to in previous numbers, was towed out into Toronto Bay, and the engines started. The internal platform on which the engines were fixed swayed slightly at first, but was steady when the boat got into motion. Mr. Knapp claimed that the boat made six miles per hour, but a gentleman who accompanied the craft in a skiff measured the speed, and found it to be three miles per hour. There was not a breath of air moving, so that the experiment cannot be said to demonstrate anything as to the seaworthiness of such a boat. After the first trial the flanges, or paddles, were extended, and a second trial—also in a dead calm—resulted in slightly better speed. Mr. Knapp has yet to convince practical seamen and marine engineers how he will obtain power to run against a gale, how he will settle the question of anchoring in rough weather, and enter and leave a port, and how he will stow and discharge his cargo. He has shown that in a calm his boat will roll; he has yet to show that it will navigate.

THE ELECTRICAL TREATMENT OF IRON ORES.*

The extraction of iron ore magnetically, where the conditions were at all favorable, has been a process long known in the mechanical arts, and not a little of the early study and advance in magnetism was due to the desire to perfect apparatus which should so simplify and cheapen the production that even the leanest deposits of magnetic ore could be worked profitably. Patents dealing with the subject run back through many years, and the litigation of magnetic ore separation has been a long one. Perhaps the most interesting chapter of history in this field, for the public in general, is that due to Thomas A. Edison, who may be said to have turned his energies seriously toward the subject as soon as he had satisfied himself that the foundations were firmly laid for the new art of incandescent lighting. No one thing at any time ever fully occupies the ceaseless activities of that great inventor, but it may be questioned whether during the last five years any other problems have equalled in interest to him those connected with magnetic separation. Hitherto no details of consequence have been given out, but he and his associates have been spending money freely to acquire the workable ore deposits, then to treat them on a large scale of technical and commercial success, and lastly, to market the various products that result from the treatment. The appearance of the present article marks, therefore, the reaching by Mr. Edison of a stage at which he sees the goal of his hopes well in view and touch; and while the data and illustrations we are here permitted to give cannot be taken as final for one whose motto is forever, "Improve," they must be broadly characterized as of a most interesting character, and as revealing the furthest attainment of human effort in the direction of cheapening iron. It should be noted incidentally that in regard to some points, Mr.

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Edison prefers for the present not to give out all the information desired.

In the mountains of middle Jersey Mr. Edison is now doing his chief work in magnetic separation, but other plants are projected. The veins near the works at the place now called Edison, not far from Lake Hopatcong, are known by careful tests to contain over 200,000,000 tons of iron rock, suitable for crushing. The rock is magnetite in a feldspar gangue, containing about 25 per cent. of oxide of iron, and it can be crushed with ease. The enterprise under prevailing conditions is rendered possible largely by its location, other sources of Bessemer ore being so remote—Lake Superior, 1,200 miles; Cuba, 1,600; Spain, 3,800, or Africa, 4,300. The investment between the Lake Superior mines and the furnaces in the Pittsburg district, consisting of railroads, double sets of ore docks, steamships, etc., as compared with the investment between the mines at Edison and the Eastern furnaces, is as 2.2 to 1.

Returning to the enterprise itself, we may state that the principal buildings are the power-house, crushing plant, stock-house No. 1, refining plant, stock-house No. 2, sand-house, machine shop, and store-room, mixer plant, briquette plant, furnace plant, and stock-house No. 3. Besides these there are 36 smaller buildings, including offices, blacksmith's and carpenter's shops, oil and residence buildings. The power plant includes 7 engines, of 1,800 h.p.; one compound triple expansion engine is that which ran a portion of the machinery department at the French Exposition at Paris in 1889. In the electrical equipment are 10 dynamos and 2 motors. Lighting current is generated for 40 arcs and 700 incandescents, over two and one-half miles of circuit. In the new dynamo room that Mr. Edison has taken much pleasure in laying out, is a cement switchboard, with iron frame, made on the spot, in a few days, for a few dollars. It is not so unornamental as it sounds, by any means.

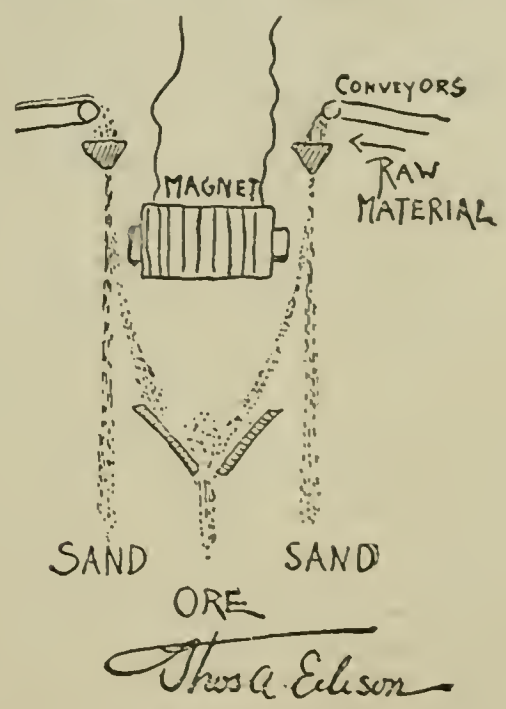
Around the property are some three miles of narrow gauge railroad track, with three locomotives, the trackage varying in length and distribution with the amount of working being done on the different veins. From first to last there is an amazing absence of human labor. All told, including night shifts and day, there are about 250 men around the place. But for the fact that from the moment when the vein is stripped, to the instant when the Edison ore briquette drops on to the outgoing car, no single hand is laid on the material under treatment, there would be two or three able-bodied regiments of laborers of all styles busily engaged on the property. At the outer extremities of these railroad tracks, work two huge excavators, one weighing 60 tons, the other 92, a third one being about to start up. Either of these will bite up four or five tons of rock every minute from the vein, and keep on doing it all through the day. Dynamite is used to get the strata in an amiable and yielding mood, but Mr. Edison considers it infinitely cheaper to do the real smashing up at the breakers, so that the rock is brought away in literal boulders. As each train of double-skip cars is freighted, it is hauled off to the crushing plant, where two 7-ton electric cranes, sturdy and effective, and one of them with earmarks of home production, lift it up and drop it into the jaws of the giant crushers, the skips being then lowered back to the trucks for the next trip. Four thousand tons of crude ore a day is fair working.

The big rolls, studded with knobs, that are a combination of claw and fist, weigh some 130 tons, of which 70 tons is in the moving parts. They are driven by a friction belt, so lightly adjusted that in starting up from a state of rest, a touch with a lever is needed for the initial impetus, when the belt and friction bring them up to full speed, with a circumferential velocity of a mile per minute. As the rock disappears between them they slow down, and the friction belt again speeds them up for the next load. The faces of the rolls are 16 inches apart, so that a 15-inch lump could go through, but nothing larger than that retains its identity.

The ore then goes to a pair of intermediate rolls, which are directly under the first, and of the same type, driven in the same way, except at a higher peripheral speed. These rolls are about 7½ inches apart. The ore passes to elevator No. 1 and is delivered to the top of the building. It then goes through three pairs of rolls 36 inches in diameter, and is reduced to particles of one-half inches, proceeding en route through a dryer which gets rid of all the ice, or snow, or moisture, and is then taken by conveyer and elevator to stock-house No. 1. The rolls are fitted with a most ingenious device, which effectively eliminates the possibility of breakage, and there is no piece of crushing machinery, pair of gears, pulley, or other moving mechanism in the entire plant, from one end to the other, that is not in some part of it connected up by "breaking pins." These in their respective sizes will just carry the work at full load. If anything goes wrong in the way of strains, or if nuts, bolts, or any foreign substances get into the machine, the pins break, and no damage is done to the machinery itself. The idea is really a clever adaptation of the safety fuse principle. The pins are sized down to one-thousandth of an inch. To the employment of this simple device is owing the fact that in all the experimental work that has been done in preparation, as well as in the actual running of the plant, the total breakage has amounted to only a few hundred dollars.

After having been delivered to the stock-house the material is taken continuously, or later, by a conveyor with iron buckets, which runs at a slow speed and has a large capacity, and is delivered at the refining plant, directly over the "three-high" rolls for further reduction. When Mr. Edison first started the work he began experimenting with ordinary Cornish crushing rolls. After making several hundred experiments as to speeds, pressures, and feeds of various numbers of tons per hour, he determined the fact that the friction of the machine was about 82 per cent. of the power applied, leaving only 18 per cent. for the actual work of crushing. He then set to work to improve the ordinary rolls, with the result of evolving "three high" rolls, which have more than reversed the former conditions, the friction of these machines being about 16 per cent., leaving 84 per cent. of the power applied to do the work. In the old type of Cornish roll it was found that the friction was largely due to a moving shaft running against a fixed bearing under great pressures; in the new machines it is so arranged that the bearing moves at the same rate of speed as the shaft, permitting great pressures with a minimum friction. The moving bearings are made up of wire ropes.

The ore is next carried to the 14-mesh screens, the portion too large to pass being returned for recrushing, while the remainder goes on to the first set of magnets. The magnetic building is 95 feet high, 28 feet wide, and 140 feet long, and will handle 300 tons of crushed rock per hour. The magnets have about one mile of face, and the ore is caused to fall in such wise and at such a rate before them, but not touching them, that the iron is deflected, while the gangue or tailing goes right straight down. The magnets are of special form,



6 feet long and 12 inches wide, in banks of 3 high, their power increasing from the top one to the lowest. At the start the weakest magnet at the top frees the purest particles, and the second takes care of others; but the third catches those to which rock adheres, and will extract particles of which only one-eighth is iron. This batch of material goes back for another crushing, so that everything is subjected to an equality of refinement. We are now in sight of the real "concentrates," which are conveyed to the dryer No. 2 for drying again, and are then delivered to the 50-mesh screens. Whatever is fine enough goes through to the 8-inch magnets, and the remainder goes back for re-crushing. Below the 8-inch magnets the dust is blown out of the particles mechanically, and they go to the 4-inch magnets for final cleansing and separation. Current at determined voltage and amperage is delivered to the magnets from special dynamos through a special regulating and indicating switchboard. Obviously at each step the percentage

of feld-spar, phosphorus, etc., is less and less until in the final concentrates the percentage of oxide is from 91 to 93 per cent. As was intimated at the outset, the tailings will be 75 per cent. of the rock taken from the veins or ore, so that every four tons of crude, raw, low-grade ore will have yielded, roughly, one ton of high-grade concentrate, and three tons of sand, the latter having also its value in various ways, to be referred to later. The sand is transported to the rear of the works, and there stored in a miniature mountain, from which it can be easily loaded into cars and carried away. The concentrate in its fine, powdery state, is delivered into the stock-house No. 2, holding 5,000 tons, or stock-house No. 3, which has a capacity of 30,000 tons. The object of these numerous stock-houses is to allow any part of the works to go on for some time, despite interruption at other points; and thus, so to speak, the "load line" of output can be kept level.

From the stock-houses the concentrates are delivered to another building and into the mixers, long, cylindrical machines equipped with paddles, called "spreaders" and "smoothers." To the mixers a binding material of special nature is fed at one end, and after being churned up, the new coherent, pasty ore is taken by conveyors to the briquetting machines in the same building. At these machines it is compressed into briquettes weighing a little over one pound, 1¼ inches thick by 3 inches in diameter. There are now 30 of these machines in use. In the briquetting machine the ore receives pressures running up to thousands of pounds on the whole diameter. The briquettes are then dropped by the machine on to conveyer bands, which transport them to the furnaces in which they are dried. They remain in the furnace about one hour, and are subjected, as they travel very slowly, to a temperature of not less than 600 deg. F. They are then carried away by the conveyer and loaded into the cars waiting on the railroad outside. The economy of labor is still so elaborated that it requires but one man to load the briquettes, distribute them in the cars, and put the cars in position, the whole thing being done by machinery actuated by the pressure of two levers. The operator can load five cars without having to change his position.

The earlier briquettes worried Mr. Edison by the amount of moisture they absorbed. Then the concentrates did not work nicely in the furnaces, but inclined to blow out, owing to the high pressure of blast, and in other ways they interfered with the regular working of the furnaces. The difficulties to overcome were serious. Very little binding material was an essential. The first cost of such material must be very low. The briquettes must be prevented from absorbing moisture, but at the same time must be left porous to the gases in the blast furnace. Finally, the briquette must be hard at ordinary temperatures, so that it could be shipped like coal, and it must not disintegrate immediately under the fierce heat in the blast furnace. To accomplish all the above, Mr. Edison tried thousands of experiments before he found the correct binding material. The briquette now made will absorb 26 per cent. of its own volume of alcohol, but repels water absolutely.

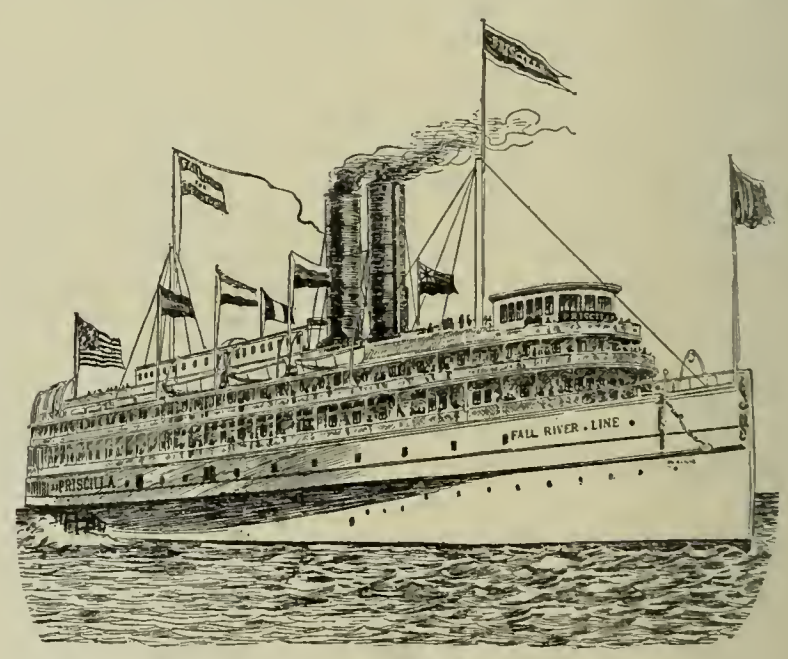
As to results in the furnace it has been found that by the use of the briquettes the output per ton of pig iron per day can be increased from 35 to 50 per cent. over the ordinary mixtures of ores now being used, with a lesser consumption of limestone and fuel. Besides, as already pointed out, this ore has but 100 miles to travel to its destination, and seems not unlikely to assume vast importance in helping to maintain the prosperity of the iron-producing districts of the East, to say nothing of its effect on the export of iron, now beginning to assume such large proportions.

Many features of ingenious time-saving, labor-saving, material-saving about the works could be dwelt on, for Mr. Edison, while optimistic and enthusiastic, is always keen after the shaving of each mill from the cost. Of new contrivances to get around difficulties there are a great number, some relating to the dust, for it is evident that in such ore-milling works the particles fly about thickly. The dust was for a long time a nuisance in the bearings of the elevators and conveyors, but at last Mr. Edison came to the conclusion that as it could not be got rid of he would turn the bane into an antidote. He now has a form of oil feed and bearing in which, after the oil is fed, the bearing is dusted over so as to prevent the oil running away. Dust from the surrounding air soon cakes on additionally, but as soon as the film grows too thick and heavy it is automatically flicked off, when the oil feeds again. The dust skin or shell reforms, and the same cycle is repeated indefinitely. The bearings are thoroughly protected, and once a month is often enough for refilling the oil cups.

The manufactured sand is sharp and crystalline, and, of course, remarkably even as to quality, besides being free from delcterious salts, etc. Natural sand, moreover, is rounded. The Edison sand has special qualities, and is a valuable element is the best cement or mortar. It is just the thing for the sand-box of the trolley car or the locomotive, not absorbing moisture. It is already in demand for various industrial purposes, and being a by-product in enormous quantities, its price is very low.

THE RICHELIEU AND ONTARIO NAVIGATION COMPANY

The Richelieu and Ontario Navigation Co. is in possession of one of the most attractive tourist routes in the world, and in order to bring large numbers of travellers to its boats it has been decided to equip the fleet with steamers which will compare favorably with any fresh-water vessels afloat. The type of construction chosen is that of the famous Fall River steamers, which are known where tourists meet together as models of all that passenger boats should be. The "Priscilla," of the Fall River fleet, is shown in the accompanying illustration, as giving a very fair idea of what the two new boats to be built by the Bertram Engine Works Co., Limited, Toronto, will be like. The dimensions are: Length over all, 277 feet; depth, 14 feet. The structural hull work is of open hearth steel. Each steamer will contain 140 state-rooms, and in addition, a large sleeping cabin below deck aft, where the dining-room generally is placed on earlier steamboat designs. The



full passenger sleeping accommodation on board is 428, the number of passengers allowed by law being over 1,500. A feature of the design is the placing of the dining saloon on the upper deck, forward, giving light, air, and an opportunity even at meals, for an unobstructed view of points of interest along the route. The tables are arranged for seating at one time 112. The chief engineer of the Bertram Engine Works Co., Arendt Angstrom, who has been with them for the last five years, is well able to build the steamers. He is a native of Stockholm, Sweden, and a graduate of the French Government College for Naval Construction. Before coming to Toronto he was for a number of years chief engineer of the Cleveland Ship-Building Company, and previous to that time was consulting engineer with the Fall River line.

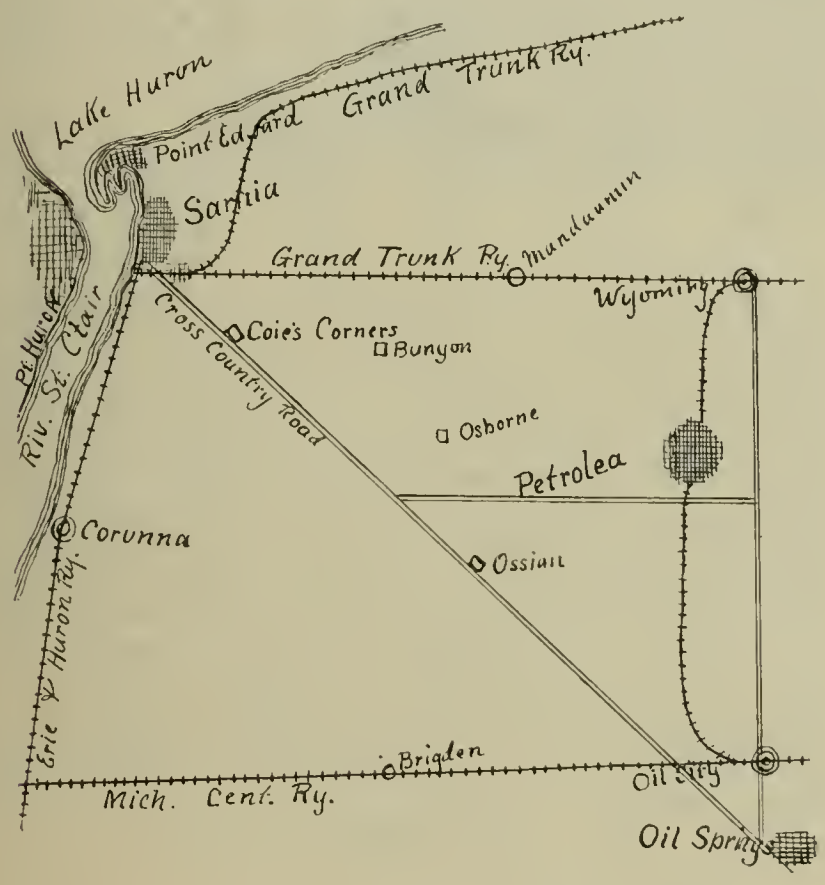
ANSWERS TO CORRESPONDENTS.

J.M., Ashcroft, B.C.—To become a marine engineer on the Canadian lakes it is necessary first to obtain a fourth-class engineer's certificate. The following qualifications are necessary for a fourth-class certificate: The applicant shall (a) be over twenty-one years of age; (b) he shall have served an apprenticeship of not less than thirty-six months in a steam engine shop, and been employed on the making and repairing of steam engines, or if he has not served such apprenticeship, he shall have been employed for not less than thirty-six months as a journeyman mechanic in some workshop, on the making and repairing of steam engines; or (c) he shall have served at least thirty-six months in an engine-room of a steamboat, as engineer on the watch; or (d) he shall have served not less than thirty-six months as oiler on the watch in the engine-room of a steamer of not less than thirty normal horse power; or (e)

he shall have served not less than forty-eight months as fireman on the watch in the firehold of a steamboat of not less than thirty nominal horse power; (f) And in any of the above-mentioned cases of service, twelve (12) months' service in a boiler shop on the making and repairing of steam boilers, may be accepted in lieu of twelve months of the service named. (g) Service in the dual capacity of engineer and fireman, or oiler and fireman, will only be accepted as fireman service for fourth, and not for any other class of engineer. (h) He shall be able to read and write a legible hand. (i) He shall understand the construction and operation of the feed-water pump, water gauges and safety valves; he shall know when a boiler is foaming, and how to stop the foaming, and also the dangers resulting from neglect to keep the boiler clean, and the usual methods of cleaning it.

PROPOSED SARNIA–PETROLEA RAILWAY.

A proposal has been made to build an electric railway from Sarnia to Petrolea, a distance of 16 miles, the scheme contemplating extensions to Point Edward at the Sarnia end, and to Oil Springs and Oil City at the Petrolea end, with an ultimate projection into the township of Dawn, which is a very rich agricultural area now being opened up for settlement, but without railway communication of any kind at present. Sarnia now has a horse-car system, operated by a local company, called the Sarnia Street Railway Company, and this company's charter, granted in 1874, gives the company authority to extend the road to adjoining municipalities within the County of Lambton, and the right of way would thus be provided for. According



to the census of 1891, Sarnia had a population of 6,692; Point Edward, which is a lake suburb, almost immediately adjoining, had 1,881; Petrolea, 4,357; Oil Springs, 1,138; and the county itself, which is a very rich agricultural district, a population of 47,715. The wages paid out each day in the oil industry of Petrolea averages $1,800 to $2,000, and those of Oil Springs about $700 a day. In summer the excursion traffic from Petrolea and the other inland towns to the breezy shore of Lake Huron would be very considerable, while the local traffic in freight and produce to Petrolea and Sarnia from the intervening rural districts would be constant and profitable. There are about 6,000 oil wells in Petrolea, and about 2,000 in Oil Springs, and the traffic due directly to the oil industry is large, and still extending. In Sarnia the new oil refinery of the Bushnell Oil Co.—one of the most complete and modern in the world—is now in operation, adding an important permanent industry to the town, while natural gas is likely soon to be a product of the vicinity. Sarnia and its suburb of Point Edward form an attractive summer resort. A wide, clean beach, affording a fine view of the immense traffic that streams up and down the St. Clair River to and from Lake Huron, together with pure water and pure air, render the scene delightful to an excursionist, while recreation is already provided near at hand in a handsome park and pavilion, a race course and bicycle track. In short, the conditions seem already complete and the time ripe for a good paying enterprise, while the whole tract being a dead level, the cost of construction and the cost of maintenance would both be lighter than usual.

A MODERN PRINTING ESTABLISHMENT.

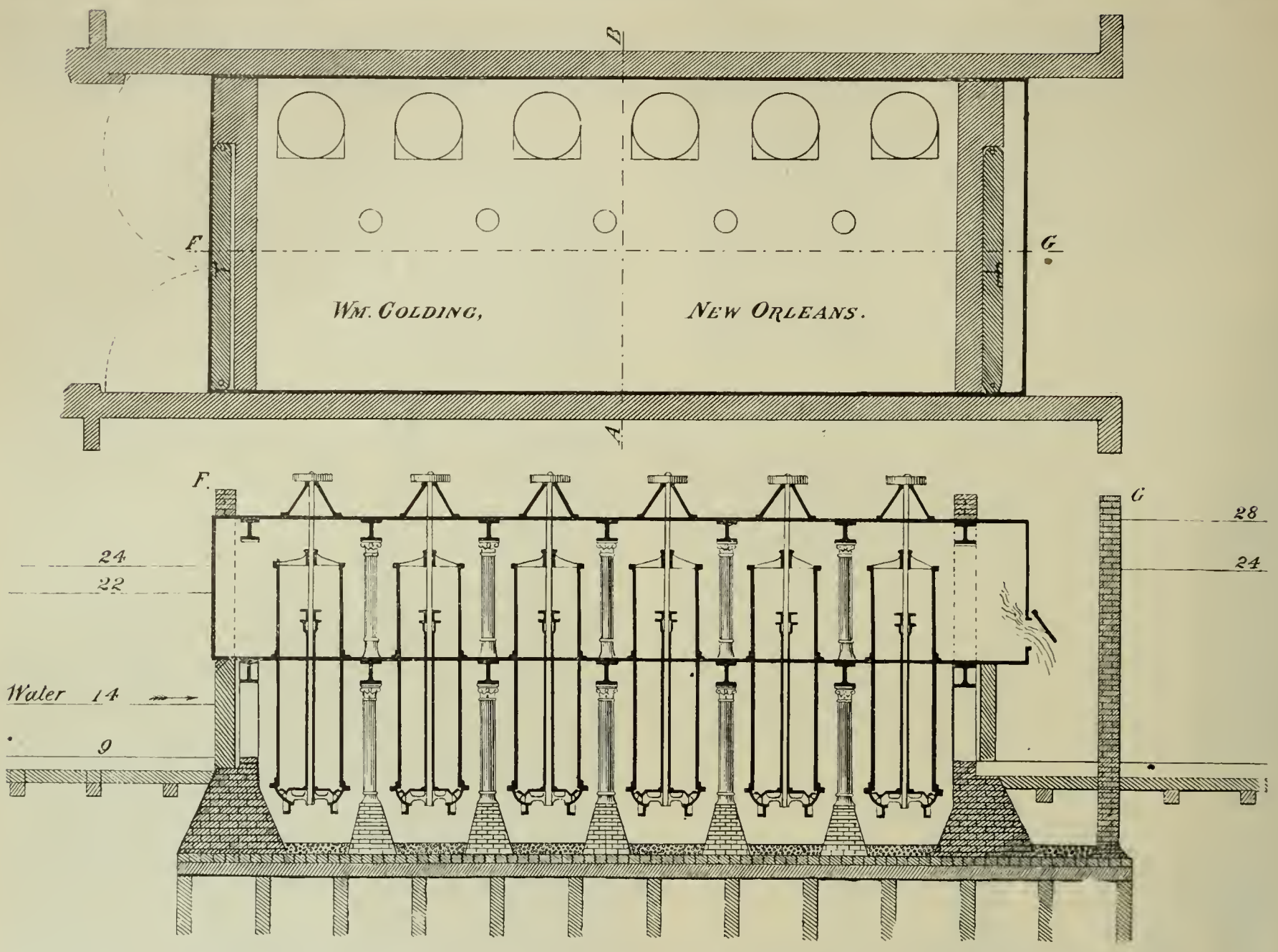
The largest printing establishment probably, in Canada, is that owned by the Methodist Church, and known as the Methodist Book and Publishing House, situated on Richmond street west, Toronto, and having a frontage also on Temperance street. The Richmond street building has a frontage of 100 feet, and is four stories high, besides basement. Here are situated the retail department, the editor's offices, and the offices of the various connexional offices of the Church, a board-room, etc., etc. The Temperance street front extends over 118 feet, on which is a six-story building, with basement, containing engine and boiler-rooms, shipping offices, wholesale book department, bindery, folding, and stereotyping rooms. Connecting these buildings is another structure of four stories, in which is contained the press room, composing room, book stock-room and general offices and a store-room.

In the press room there are eighteen large cylinder presses, two of which are perfecting or double presses, a full complement of Gordon presses for small work, a folding machine, paper cutter, and everything necessary for turning out work expeditiously. The composing room is a handsome and airy apartment, with frames to accommodate about eighty compositors. Two linotype type-casting machines of the latest pattern form part of the equipment. The bindery has the latest and best machinery for turning out all kinds of binding work in leathers and cloths. Here will be found embossing presses, cutting and trimming machines, gilding, sawing, sewing, wire-stitching, backing, and case-making machinery. The stereotype and electrotyping room is complete with dynamo, casting boxes, sawing machine, routers, bevellers, furnaces and all necessary tools.

The buildings are heated entirely by steam. The mechanical departments by exhaust from the engines, the front building, offices, etc., by the low-pressure gravity system. In the boiler-room are two 60 h.p. boilers, made interchangeable for high and low pressure. These are fed by a Northey steam pump. In the engine-room are three engines, two Wheelocks, 60 and 90 h.p., connected to an underground shaft by large belts, and arranged with friction-clutch pulleys, so that either engine or both may be used at any one time. The building is lighted by electricity, generated by a 10½ by 10 in. Ideal engine direct connected to a 30 kw dynamo, which has lately been installed by the Toronto Electric Motor Co. The generator provides current for 650 16-c.p. lamps. From this machine there can be run as well, however, through motors, arc or incandescent lights. The armature of the generator is of the wave-wound type, with ventilated core, the armature being so constructed that no wire passes over the ends. Consequently no dust or dirt is allowed to accumulate. The crown is of heavy iron, with the laminated poles cast in so that the magnetic current is perfect. It is the most modern type yet out, and is the first of the kind ever built in Canada. It has run with a superlative smoothness since its installation. The establishment is protected against fire by two large stand-pipes running from cellar to roof, with hose on each flat attached and ready for use. G. C. Mooring has charge of the steam plant and machinery, and has been with the firm over eight years. He is a chartered member of Toronto No. 1, C.A.S.E., and having always taken great interest in the work of the order, he has recently been elected president of the Toronto Association.

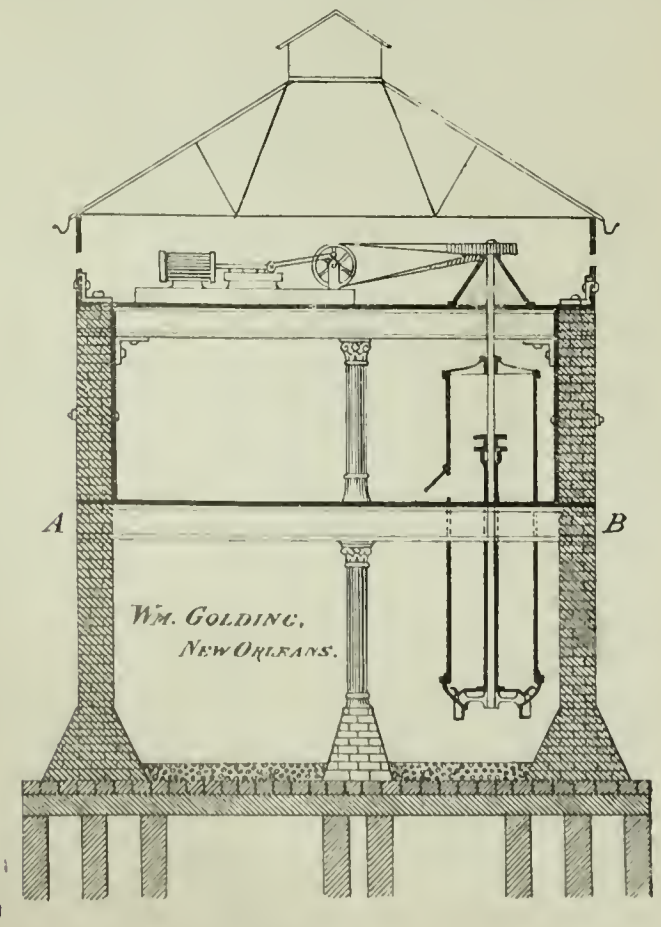
This thriving institution had a humble beginning in 1820, and has attained its present high position by steady and persistent energy, combined with honorable dealing. During the past decade, under the management of the present book steward, Rev. Wm. Briggs, D.D., its growth has been phenomenal, and notwithstanding that it has but recently moved into its present quarters, its expansion has been such that it was found necessary to acquire additional ground to permit of extensions in the near future.

ROBERT JAMIESON, the chief engineer of the West Kootenay Power and Light Company, which is putting in a big electrical plant on the Kootenay River, says work is being pushed in all departments of the enterprise, and the company expects to be supplying power in Rossland, B.C., by December 15.



PUMPING PLANT.

The accompanying illustrations show a system of pump installation, in which the water is lifted no higher than is necessary to effect the discharge, against the varying surface heights of the out-fall receptacle. Steel beams cross the walls at A. B., upon which is placed a steel tank, through the bottom of which are suspended several centrifugal pumps, which receive



the water from the pit, and deliver it into the tank, from which it flows to the out-fall receptacle. The bottom of the tank is placed on a level with the minimum height of the out-fall receptacle, while the top of the tank will be placed above maximum height of out-fall receptacle..

The pumps will be placed on one side of the tank, in order to form a by-pass for the water to run through without pumping, when the conditions are favorable. On the top of this tank will be erected a suitable building of iron, in which will be placed the operating machinery. It will be understood that if the surface of the out-fall receptacle should rise to line 24, the valve shown at end of tank would close, and would remain closed until the water inside of the tank was raised higher than the water on the outside. The motive power, either steam, gas, or electricity, will consist of a motor for each pump—the object being to start one pump at a time, as the water commences to flow. Where the conditions are such that the maximum height of the out-fall receptacle exists but a small portion of the year, the advantages of this system will be fully appreciated. This pumping system is the invention of Wm. Golding, C.E., New Orleans.

THE NAVIGATION OF THE AIR.

Editor CANADIAN ENGINEER :

Balloons to date have always been symmetrical in cross section, or around on either vertical or horizontal axis of rotation. They have been spheres or spheroids, and when the latter, sometimes oblate, sometimes prolate, that is, elongated as the lemon, squat or flattened at the poles, as with the orange or the apple. They have also been made ovoid, as the egg, and even spindle-like, as the weaver's shuttle; but always symmetrical in any and every section, perpendicular to the axial line.

Thus there has never been an attempt, as with flying machines, to imitate in a balloon the shape of a bird on the wing; and yet there should be, there must be, to be successful in directing them, as man has become in propelling vessels through the water by building them in imitation of the fish. Nor will flying machines ever prove a success until some closer imitation has been arrived at than heretofore, of the winged denizens of the air. These have been supplied with machines which have to perform the double duty, not only of propulsion through the air, but of ministering the while to their buoyancy.

This necessity must be eliminated, and can be, in flying machines, by having a space inclosing structure, approaching in point of weight to that of a more or less perfect vacuum, by

inflation, as is usual, by a lighter gas than air, as hydrogen — some fourteen times lighter, bulk for bulk, than air — and this requiring less place or bulk to do the needful, or with the heavier coal gas, by increasing size of air buoy. Thus, as it is, the balloon is buoyant, but without the proper shape to render it possible to direct its motion, while the sky-flyer is deficient in the opposite sense of having the power of direction without the buoyancy.

Now then, let us try to conciliate or combine the two requirements or desiderata; for as there is so to say but one kind or shape of fish or vessel to navigate the sea, there can also be but one kind of vessel to navigate the air; and the balloon and flying machine as now distinct from one anotner, must be blended (except for mere ascensional, observational, or meteorological purposes, where the balloon as now made may suit the purpose) into one and the same structure, and as closely as possible approximating to the figure of a bird on the wing.

This may be done by building the balloon or sky-flyer more or less crescent-like, or in the shape of a crescent in its cross section or that perpendicular to its axis of direction. The bird gains buoyancy by plying its wings, spreading them concavely to the air, as a swimmer does with the hollow of his feet and hands against the water which he leaves behind him, and preparatory to another stroke, lengthens out his feet and hands to their minimum cross section to draw (the feet) or thrust (the hands) forward for a renewal of the action; the same again as to propel the boat, the blade of the oar is held flat against the water, and then turned edgeways, pending the interval required for another stroke; or again, the same as with the paddles of a steamer, as soon as they have done their duty in and through the water, they are made to turn edgeways before leaving it, to prevent back-water. This must be done, or no success will be forthcoming. The bird must be imitated, both in its shape and in its motion. Watch it then carefully, look at it from beneath when you get a chance of doing so. We have already seen how it ascends by the ply of its wings. Now it has attained its height, and soars aloft, no more by the motion of its wings or by moving them, but by spreading them, and it spreads the feathers of its tail, till they reach and underlap them, and then you have the surest parachute. The bird, though, must move or soar as it is called, but it does so bodily, or as a whole, now acting as the kite or as the aeroplane, which the slightest motion keeps afloat, either by its own advance in perfectly still air, or by the motion of the air in the contrary direction, when the kite, or bird, or aeroplane, moves against the wind or breeze; and similarly does and must the cyclist move when soaring, so to say, on his wheel, or at a standstill or slow motion, by curving slightly to one side, then the other, to retain his vertical position in space.

But there is another cause which helps the bird to soar on air, and which I do not remember as yet to have seen noticed, any more than does the centrifugal action of floating ice or other objects, such as the remains of the "Jeannette" or other wreckage, appear to have ever been taken into the calculation, or in any way considered as a factor in the computation as well as circum-polar currents, etc., in Arctic navigation.

This is the very heat generated by the bird's body, and we all know how immensely hot a bird feels when you hold him from beneath. This heat then imparts itself by radiation and conduction both, to the air contained in the concavity between its wings, it heats this air and thus rarefies it and makes it lighter, with the tendency, if not to further lift the bird in space, at any rate, to keep it there or on the wing, and prevent its tendency to fall, which it would do, or at any rate, descend, as with an ordinary non heat-generating parachute.

And this soaring of the bird, the bird of prey especially, is due to its meat or flesh-devouring propensities, and of fatty and oily substances creative in the blood of vast amounts of carbon, which, when brought into contact with the oxygen of the air in the bird's act of active respiration, sets fire, so to say, to the interior, with the effect alluded to of thus maintaining its not otherwise-to-be-explained faculty of keeping almost indefinitely on the soar.

Again as in the so-called ball-cock mystery, of which I was the first to explain the apparent paradox; buoyancy, or additional or increased buoyancy might be obtained under a parachute or flying machine of the kind, by causing a jet of steam from a boiler of the propeller, if such were used to give motion to the flyer, or a jet of gas of any kind, or of atmospheric air, to issue from a reservoir of compressed gas or air, or from an air or gas compressor worked by the engine, and either by electricity or any other motive power, to issue from a conical nozzle with a ball near its apex, or from the conic space between two concentric cones, and at such an angle as required to cause the funnel-like jet to pass out in contact with the circular periphery or outer and lower edge of a conical or concave roof or ceiling to the flyer, which (the jet) as in the case of the similarly shaped water nozzle, would, by the mere effect of its friction on the air contained beneath the parachute-like covering, roof or awning, suck the air from the space enclosed between the awning and the funnelled jet of gas or air in a way to form a vacuum or partial vacuum within; and again, in this way be productive of the buoyancy required to float the flyer, and allow of applying the power of its motor or the balance of such power, as the case might be, to the propulsion of the bird-like structure through or into space.

But better still, let the buoyancy be provided for in advance of starting, by making the structure a balloon or space-enclosing one, and let the car and motor be held beneath the balloon in the concavity between its horns, already spoken of, by building it as said, of crescent-shape in its cross section. Its weight might be borne by rods or ties from horn to horn, or it might be suspended to the under or concave side of the aerostat or to suit its height to all requirements, its head might rise air-tight, of course, into the very balloon itself, and be there maintained in shape by suitable light steel ribbing.

Now on either side the car and perpendicular thereto, or symmetrically and at whatever angle, there might go forth axles of motion, and these axles might either pass beneath or through the pendant horns of the crescent, coupled thereto if passing beneath them, or if passing through them, would do so through fixed tubes concentric in direction with that of the axles, and with joints at either end made impermeable to the space-filling medium of the air-ship. Then to the ends of these axles, projecting as required beyond the tubes, would be attached such paddle-wheels or motor-blades as required to propel the ship through space; and by making the axles separate or capable of separate action, the one from the other, both would be made to revolve or work at the same velocity for straight motion or motion ahead in a vertical plane, or one of them to work slower than the other when starting on a tack, or the one backward and the other forward for speedy rotation of the vessel or a change in direction, end to end. And if the tail-end of the aerostat were provided with a rudder, this could be easily worked from the platform of the car by an endless chain or rope passing through sheaves and pulleys attached to the bottom or concave side of the imitative bird, or again a screw or helix,, or a pair of them (twin screws) could be as easily handled from the car.

I have as yet said nothing of the balloon in longitudinal section, nor of its plan or shape as viewed from above or below; but from what I have said about a bird-like structure, it will have been inferred that the rear end of the airship should be like a lobster's tail, and the whole bag of gas fan-like in plan, while its head or nucleus should, except for its concavity beneath, be like that of Newton's great comet of 1680, Halley's comet of 1835, the six-tailed (feather-like) comet of 1744, that of 1811, and even those of by-gone ages, as of A.D., 1006 (supposed to be Halley's, of 1835), are described in the annals of the time as exhibiting a tail in the form of a scythe, as if their mighty flight through space (at a million miles or more an hour when under perihelion influence) as if concavity of the tail while traversing ethereal space, were akin to that formed by birds traversing atmospheric space, or that their heating of the ether in their concave surface had something to do with an ethereal vacuum supporting them in space.

But I had better keep out of ether and get back into air, with the concluding remark that such a shape of balloon cross-section would, in case of collapse or of a rapid coming down, in case of a burst or rent in its enclosing skin, cause it to fall on its horns, which, being made of certain amplitude or thickness and lower rounded edges, as I should have said before, would act as buffers on land and water to deaden the fall or force of impact. The balloon, it is likely, should be ribbed, and all its ribbing and impelling machinery be made again in imitation of the bird, of light steel tubing (birds' bones being hollow), thus affording increased strength with less material, and as such ribbing would, even in case of a burst and escape of gas, maintain the shape and keep the enclosing material in position, this would be highly conducive

to the prevention of accidents, since even without the gas within it, the outspread cotton, cloth, or silk, or of whatever material the coverings were made up, would be sure to stay the velocity of descent and effectively prevent casualties, and here again we take our cue from the bird; for though when, after soaring it perceives its prey, it swoops or shoots down like an arrow, closing its wings and the feathers of its tail the while, but when near the earth it spreads them again to break its own fall, which otherwise would prove as fatal to it as that of a man not armed with a parachute for the purpose of retardation.

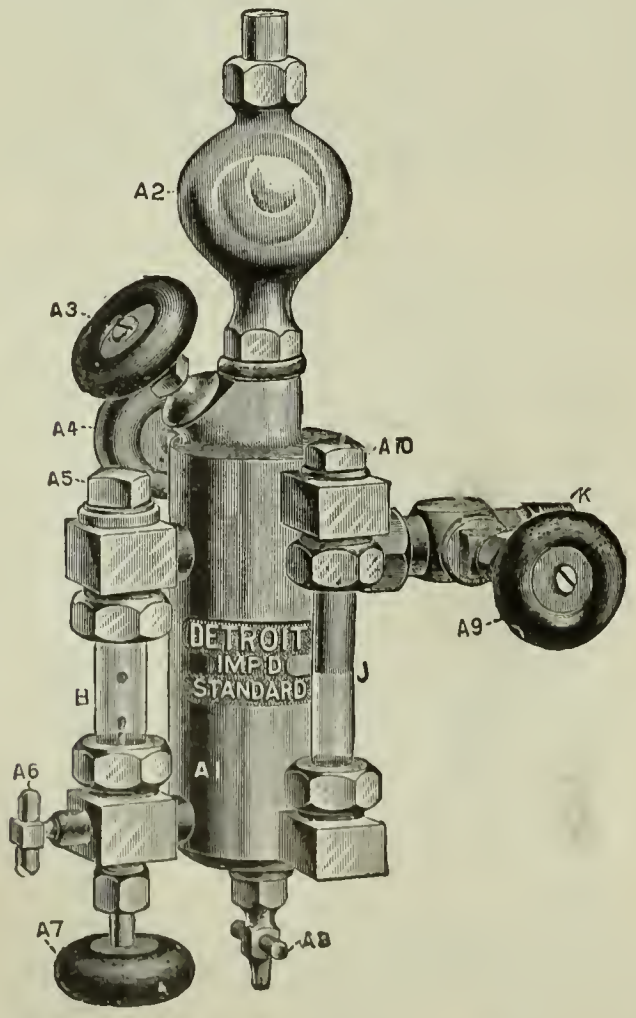
Quebec, October 25th. C. BAILLAIRGE, C.E.

LUBRICATION OF STEAM CYLINDERS.

Proper cylinder lubrication is a much more prominent factor in the performance of the steam engine than most engineers or engine users suppose. For years its importance has been recognized by the experts, the inventors and designers of high-grade engines, and a more correct estimate of its influence has pervaded the rank and file; still, it will be a matter of surprise to many to learn that with the exception of the initial condensation of steam, the greatest loss about a steam engine is due to the friction of the slide valve and piston.

In their new catalogue, just received from the Detroit Lubricator Co., of Detroit, Mich., is given some very interesting data on this subject. It consists of reports of the results of tests made at one of the most prominent testing plants in the United States, not by the makers of lubricators, but by mechanical engineers, who are purchasers and users of these articles. These tests proved that with a well lubricated slide valve and cylinder, an engine can do 35 per cent. more work than when these parts are not well oiled. That these results are not exceptional, it might be added that they have been approved by a great many of the leading American engineers, and Prof. R. H. Thurston, of Cornell University, in his book on Friction (recognized as the standard work on this subject in engineering circles of the United States and Europe), estimates the loss due to imperfectly lubricated slide valves at from 25 per cent. to 50 per cent. of the energy of the steam used.

Sight feed lubricators are designed to prevent this loss of power. There are different kinds of different degrees of merit,

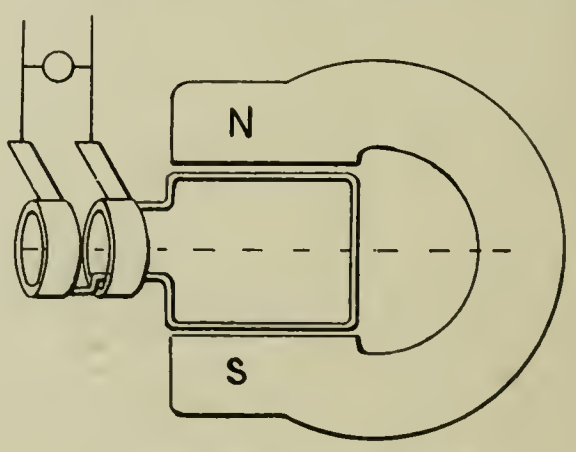


some very crude, and many very thinly disguised imitations of antiquated patterns. As an illustration of the progress that has been made in these devices, we insert cut of the improved standard lubricator for stationary engines, made by the above-named company. In it are included all the improvements and advantages, which in their more than 20 years' experience, they have found to be necessary or desirable. Among these advantages is its heating channel. This extends through the body, between the upper sight feed arm and the support arm, and it is always filled with steam from the steampipe. Thus, no matter how cold the weather, or how heavy the oil, the same number of drops per minute is always maintained, and perfect lubrication assured under all circumstances. The globe valve in the support arm makes it easy to attach, and allows the lubricator to be removed at any time, for repairs or otherwise, without letting down steam. The necessity for repairs, however, is a rather remote contingency, as each lubricator made by this company is tested at a pressure of 300 lbs. before it is allowed to leave the factory. Perhaps the best evdence of the merit and popularity of these goods is the fact that more than 350,000 of them are in use on the engines of almost every country of the globe, so that their motto, "We Lubricate the World's Machinery," is not such an exaggeration as might at first sight be supposed. Our readers will find the new catalogue referred to, to be quite an acquisition to their library, and very useful for reference. It shows the full line of sight feed lubricators, kerosene oil injectors, glass and brass oilers, oiling devices, valves, low water indicators etc., made by the Detroit Lubricator Co., and a copy can be obtained free by addressing the company at Detroit, Mich.

DIRECT AND ALTERNATING CURRENTS.*

You are all aware that direct or continuous currents are so called from the quality which they possess of maintaining a uniformity of direction of flow with regard to the conductor through which they are passing. Direct currents, however, are not always of constant pressure; but are often intermittent or pulsatory in their character, and under such conditions exhibit many of the characteristics of alternating currents, which are constantly fluctuating with more or less rapidity from a positive value to the opposite or negative value many times in a second. The frequency of commercial alternators varying from 25 to 140 complete periods or cycles per second.

I shall not attempt in the short space of time you have to listen to me to-night to skim over the whole field, but will confine my remarks more particularly to the kind of electric currents the steam engineer is more apt to come in contact with. The rapid strides that electricity is taking makes it important that all should familiarize themselves with the laws governing this subtle force. Most any of you are liable to be placed in a position where you will have charge of one or more dynamos for generating electric current for lighting or power purposes, and it is to dynamo electric current that I shall more particularly refer to-night. I assume that you are aware that metallic substances are good conductors, copper being the best commercially. Also that most other substances are poor conductors, some being such poor conductors as to be termed insulators, such as glass, porcelain, dry wood, paper,



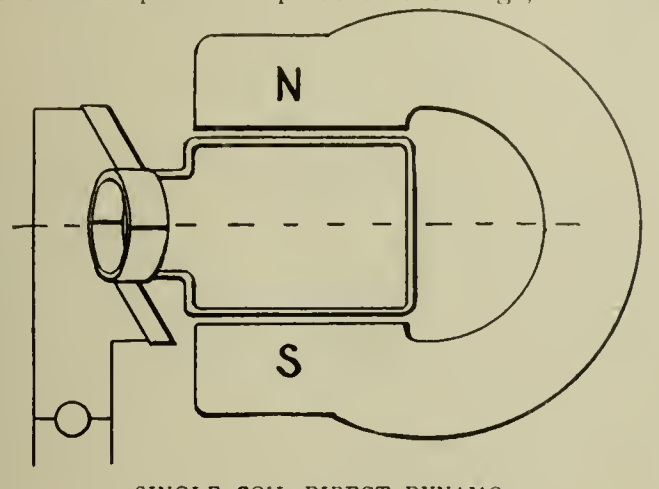
ALTERNATING CURRENT DYNAMO.

and cloth. The great Faraday, who may well be called the father of the electric dynamo, discovered in 1831 that when a coil of wire was made to approach a magnet, an electric current was momentarily established in the coil, as indicated by the deflection of a galvanometer connected in circuit with the coil. This discovery was followed by a series of experiments probably unequalled in any branch of scientific research for brilliancy of perception and clearness of reasoning power. This philosopher, before his death, gave to the world the fundamental principles upon which the dynamos of to-day are constructed.

Starting with Faraday's principle of induction, let us construct a very simple form of dynamo. Take an ordinary horse-shoe magnet, and for simplicity I will show a single

*Paper read before the Canadian Association of Stationary Engineers, Toronto No. 1, by F. H. Leonard of the Toronto Motor Co., 20th Oct.

turn of wire arranged to revolve in the magnetic field, if to the two ends of this coil of wire we attach a pair of rings, and on them place two strips of thin sheet copper for brushes to conduct the current to the outside circuit. We have all that is essential for our dynamo. If in the circuit of this elementary dynamo we place a galvanometer—which is an intrument for indicating the flow of electric currents—we shall find that as we turn the coil about there will be a deflection of the pointer of our instrument, first in one direction, then in the opposite, as the coil in our dynamo assumes first one, then the other position with regard to the magnet. We have produced then an alternating current. If we wish to obtain direct currents, we must change our construction, and substitute in place of our two rings a commutator, which in its simplest form consists of two sections. We will split a piece of tube in two, and mount it on the spindle in place of the rings, connecting one

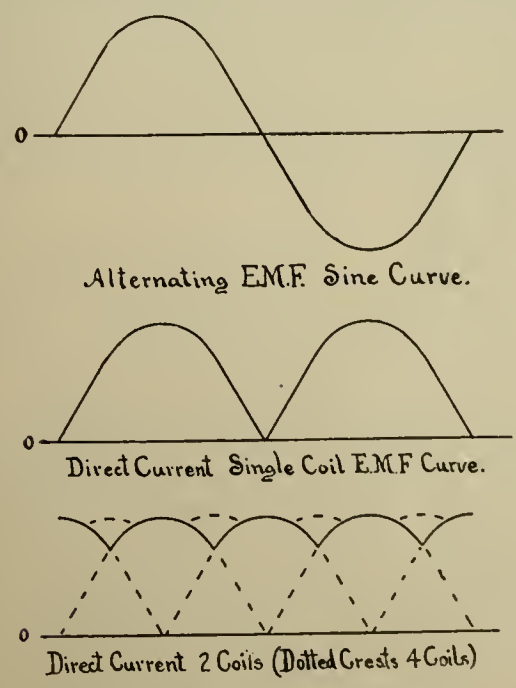


SINGLE COIL DIRECT DYNAMO.

end of our wire to one part, the other end to the other part, insulating the two parts from each other, so there will be no electrical connection between them. Again, we rotate the coil, and we shall find the galvanometer deflection takes place always in the same direction, but comes to zero at each half revolution of the coil. We can represent by a curve just what takes place in the coils or armatures of these two forms of dynamos during the period of one complete revolution. Just as the steam engine indicator represents the pressure at every part of the stroke, so our curve will show the electro motive force at every point of the revolution.

The E.M.F. (electro motive force) curve of our alternating dynamo, starting from a line of zero potential, will rise more or less abruptly, depending upon the design of the dynamo to a point of maximum positive potential, then droop, and passing the neutral or zero potential line, descends to the point of maximum negative potential.

The most desirable form of all-round work, and the one which most modern, well-designed alternators follow, is the sign curve. Though many single phase alternators, which are perfectly satisfactory for lighting purposes, depart considerably from this form and show a peak-topped, and some a flat-topped, curve. The E.M.F. curve of our direct current dynamo differs from the alternator for the reason that the commutator replacing the collector rings slips from under one

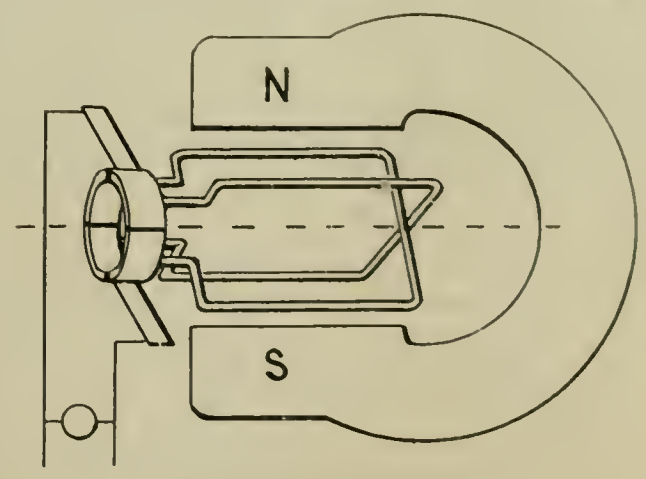


brush to a position under the opposite brush, just at the moment the current in the coil is about to reverse, and instead of descending below the zero line, it again ascends, making in a complete revolution two curves, similar to the first half of our alternating current curve, both of which are above the zero line. Such a curve represents a series of impulses following each other with every half revolution, and would not make a satisfactory current for practical working. Other evils would also creep in, as we multiplied the number of turns to obtain the commercial voltages which would produce vicious and destructive sparking at the commutator.

To obtain a commercial dynamo for direct current we must then alter our design, and instead of using a large number of turns of wire in a single coil, we must divide these turns into a number of smaller coils, and furnish segments in our commutator to correspond with the increase in number of coils. We will first see the effect of two coils spaced equally around the periphery of our armature with a segment attached to each end of the coils.

Now, if we trace an electro motive force curve from this armature, we shall find that the pressure does not fluctuate so much as with the former arrangement, and instead of dropping to zero at each half revolution, the pressure is always maintained at a point of considerable pressure, for the reason that soon after a coil has passed into a position in the field, where the rate of cutting lines of force is less, the commutator sections corresponding to this coil have slipped from under the brushes, and the sections connected to the other coil have passed under and into contact with the brushes, and supplies the circuit with a fresh E.M.F. rising in potential, the other coil in the meantime is out of circuit or idle. If, instead of two coils we employ a still larger number, we continue the process of smoothing out till we finally get a practically constant pressure throughout the revolution. Also, as we multiply the coils we shall find it desirable to avail ourselves of the E.M.F. generated in the coils, which are not in a position of maximum potential, and utilize the potential of coils rising to maximum and descending to zero; this will also materially reduce the sparking at the commutator. Thus, all the coils in a commercial dynamo are connected together, and loops taken to the segments of the commutator, except in a few cases, notably the Brush arc dynamo.

So far the dynamos we have been considering have been constructed without iron in the armatures, but as iron is a much better conductor of the magnetic lines of force, which are depended upon to induce the E.M.F. in our coils, it would evidently be better to introduce an iron core into the structure, thus reducing the reluctance of the magnetic circuit. Also we have used a permanent horse-shoe magnet, whereas we can obtain a much more dense and powerful magnetic field by using an electro magnet, which may be obtained by passing the electric current through a coil of wire surrounding an iron core. The shorter and thicker we can make the magnetic circuit, the less energy there will be required to produce the magnetic field, and wide air spaces are to be avoided, as they offer serious resistance to the flow of lines of force through



TWO COIL DIRECT CURRENT DYNAMO.

the magnetic circuit. Part of the electric current generated by the dynamo itself is generally utilized to excite the field of direct current dynamos, though alternators are usually separately excited by a smaller direct current dynamo. What applies to the magnetic circuit in a direct current dynamo is equally true in regard to an alternating current dynamo. Care must of course, be taken, to insulate the copper of the electric circuit from the metal which is used for the magnetic circuit, as well as to insulate the various turns or convolution of the electric circuit from each other, so as to avoid short circuits.

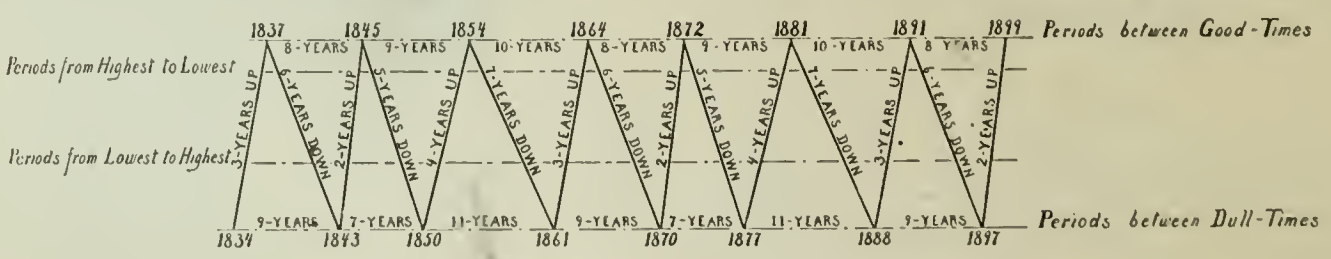
From what has been said, I trust you have been able to form a fair idea of the manner of obtaining both alternating and direct currents by means of the dynamo electric machine,

which is only a piece of apparatus for transforming the mechanical energy of the water-wheel or steam engine into electrical energy. There are several types of direct current machines, but they can be divided into two principal classes—constant current dynamos and constant potential dynamos. The constant current dynamo is used principally for arc lighting, the flow of the current remaining fixed while the E.M.F. increases as the arc lamps or other devices are added in series. The constant potential dynamo is the type generally used for incandescent lighting and power purposes. This type of dynamo is designed to maintain a constant E.M.F. or pressure, and the current is increased as lamps or motor are added to the circuit in multiple. Alternators are also built for constant current and constant potential, though the former are not much used at present.

Direct currents are generally used at low E.M.F., 110 to 125 volts being common for lighting plants, though in arc dynamos the pressure in the larger sizes reaches as high as 8,000 volts. At 110 to 125 volts, of course, large conductors would be necessary to supply any considerable amount of energy, which necessarily confines this type of dynamo to limited areas, so the work can be reached without too large an expenditure for copper conductors. The alternating currents, however, on account of the facility with which they can be transformed from a high to low voltage or vice-versa, without the necessity of any moving parts in the transformers or convertors, as such devices are called, are generally used for transmitting energy to greater distances, and for distribution covering areas of many miles, the Niagara power being transmitted 26 miles to Buffalo by alternating currents generated by 5,000 h.p. two phase alternators at 2,000 volts transformed to three phase alternating currents at 10,000 volts for the transmission, and at Buffalo transformed from 10,000 to about 340 volts alternating, which is then transformed by rotary transformers into direct current at about 550 volts for supplying the street railway motors. As can be seen from this instance, the flexibility of the alternating current system is wonderful, particularly when it is understood that these transformations take place in the static transformers with a loss of less than 2 per cent. for each change, the greatest loss for any change being in the rotary transformer, and even this is obtained at an expense of about 5 per cent. Under the high pressure alternating currents are transmitted with allowable loss and transformed to the lower and safer pressures on the spot where the current is to be utilized. It is difficult in so short a space to give much of an idea of either direct or alternating currents, not to mention their differences, but have tried to touch on a few points, which I hope will awaken sufficient interest to bring about a deeper study of the subject.

PIG IRON AS A TRADE BAROMETER.

It was Lord Beaconsfield who pointed out that the chemical market was an indicator of the trade conditions of the world. When chemicals were active, trade and manufactures flourished, and when the chemical market was depressed, trade languished. F. S. Evans, of the well-known bicycle firm of Evans & Dodge, Windsor, Ont., shows that pig-iron is even better than chemicals as a trade barometer, as it is the only great staple that is affected by nothing but the law of supply and demand. Mr. Evans has, with great patience, worked out the accompanying graphic table, showing the fluctuations in pig iron back to 1834, these being taken from American prices current, as quoted in the markets and trade papers. It is remarkable with what exact regularity the periods of high and low prices recur, not only in these short cycles, but in the long cycles. For instance, taking the range of highest prices, we have a long cycle of eight years, nine years, and ten years, recurring in the same period as time goes on; and in the lowest points there are similar periods of nine years, seven years, and eleven years, which are repeated in regular order from 1834 till now. Projecting the lines forward into the future, we find that prices will continue to rise till they reach their highest point, in 1899. It may be noted that the present tendency of prices in pig iron confirms the correctness of Mr. Evans' instructive table.



EVAPORATIVE CONDENSER OR COOLING TOWER.

Recently President E. J. Philip lectured before the Hamilton branch, C.A.S.E., on this subject. The substance of his remarks was the same as his paper read at the Brockville convention, and published in full in the September number of THE CANADIAN ENGINEER, with some additional explanations and matter, bringing the discussion up to date. We append the portions of his lecture not found in previous numbers, the whole making a complete statement of the question:

The evaporative condenser or cooling tower is made to operate where the supply of water is limited, or where it has to be bought. This apparatus is in every way the same as an ordinary condensing plant, except that in addition to the air-pump and condenser there is a tower for cooling the water after it has been heated by condensing the steam. Its construction will be taken up later on.

This apparatus is the outgrowth of the increasing number of steam power plants in recent years, with vastly increased h.p. capacities, which has of necessity raised the price of the lower grades of coal. Whenever fuel goes up in price, or where the quantity is increasing, due to increased load, the steam user begins to look around for some means of reducing the rising fuel account During the last few years, engineers have had every opportunity to put in what may be called "ideal plants," and others have had the opportunity to improve the plants under their control. How far many have succeeded is known only to themselves; if any part is a success it becomes known, and is copied or improved on. The principal improvements during the last few years have been due to higher steam pressures, increased number of cylinders, and where water was at all available, running condensing; and the absence of water in sufficient quantity to use for condensing purposes at a point where it is desirable to locate a power plant, has caused it to be located at some remote or less desirable point, the necessity of having water for condensing purposes being recognized as leaving no alternative. The cost of running condensing and using water from a city main is out of the question, as it costs more for water than is gained by condensing; this being the case, it formerly left no alternative but run non-condensing, or build the plant where there was an abundant supply of water without regard to the disadvantage of the location.

This has been overcome by improvements in an apparatus that has been used for years in a crude form for other purposes. The first purpose it was used for was for cooling water that had been used for cooling beer This form of tower was simply a square frame work, filled with brush or limbs of trees, the water was pumped to the top through a sprinkler, and in falling over the loose brush it spread out in thin sheets over the surface of the wood, and was acted on by the air, the warm water causing a current of air to circulate through the filling. The present tower is simply an improvement on the original form, and when used in connection with a steam engine it takes the place of a natural source of water supply. With this apparatus a plant can be made to run—condensing, with less water than it can run non-condensing. The reason of this I will explain after a description of the tower, which will now be in order: The cooling tower is usually square or rectangular in form, but it is sometimes made round, and is filled with partitions. The partitions may be made of any material. The Worthing tower is filled with tile, the Barnard tower is filled with wire netting, the Gradier with wood, and sheet iron has been used by different parties. Any material that will give a large surface will do, the object of the partitions being to spread the water out in thin sheets over the surface. The partitions do not extend to the bottom of the tower, but a space is left below them into which a fan discharges air. At the top of the tower a distributer is attached

to distribute the water over the partitions. Now, the action is this: Imagine an engine running condensing, and taking its injection water from the bottom of the tower (into which a quantity is put when the tower is first started). Now, when this water has condensed the steam, and passes on to the air-pump, instead of the pump discharging the water to the sewer, it discharges it to the top of the tower into the distributer, where it is evenly distributed over the filling. It spreads out in a thin film or sheet, and passes slowly down the partitions. The fan is running, and its air is passing up between the partitions, and acts on the water in two ways, thereby cooling it by the time it reaches the bottom of the tower sufficient to again condense more steam. The way in which the water is cooled is: First, the water looses some of its heat by radiation from the piping between the tower and condenser, also from the sides of the tower. Next, the air is raised in temperature, carrying off heat in this manner, and the last, and by far the greatest cooling effect, is obtained by the air evaporating a certain quantity of the water, carrying off heat in the vapor as latent heat.

I made the statement that with this apparatus a plant can be run, condensing, with less water than it can be run non-condensing, and I will try and prove this. Take an engine running non-condensing, and using, say 25 pounds of steam per h.p. per hour, and taking its water from the city main; if it is, say 100 h.p., it will use 2,500 pounds per hour. Now, this water is being exhausted out into the air in the form of steam. If we attach a condenser and cooling tower to the engine, and it saves at the engine, say 20 per cent., the engine will use 20 per cent. less water, which will make the water consumption 20 lbs. per h.p. per hour, or 2,000 pounds per hour for the 100 h.p. When condensing, instead of the water passing off as exhaust steam, it is pumped into the cooling tower, and for every pound of water evaporated by the air, sufficient heat is carried off to cause a cooling effect sufficient to condense one pound of steam. If all the cooling effect that took place was due to evaporation, there would be water neither gained nor lost, as there would be as much evaporated as condensed, but as I said before, a certain cooling effect by radiation takes place, and the water cooled in this way can do the work of cooling, and is not evaporated. Then the rise in temperature of the air carries off considerable heat without evaporating any water, so that between these two, sufficient water is saved to cause a slight overflow from the tower all the time, and as the boilers are using 20 per cent. less water, it follows that in this way you are running condensing with 20 per cent. less water than you can run non-condensing.

The tower that was built this summer where I am employed is a rectangular structure, 19 feet high, with a vapor stack on the top, 9 feet in diameter, and 26 feet high; the body of the tower is 10x12. It has an 18-inch water space at the bottom, and two five-foot fans. The filling is 12 feet long, and principally wire. The distributer is made of pipe, and works very nicely. The tower runs in conjunction with a 500-h.p. surface condenser, with combined air and circulating pumps, built by the Northey Co., of Toronto. The condenser has 800 brass tubes 8 feet long, making over a mile of tubing, with 1,600 stuffing boxes. The water leaves the condenser at from 120 to 128 deg., and is cooled by the tower to from 68 to 90 deg., according to the amount of air. It is possible to get almost any cooling effect by varying the quantity of air; the water has been cooled to 60 deg., with the outside temperature at 78 deg.

DYNAMO TROUBLES AND HOW TO OVERCOME THEM.*

With modern uses of electricity, the increase in the demand for light and power has, in many cases, proven too much for modern power stations to meet. These plants, installed ten or fifteen years ago, when the general application of electricity to purposes of illumination first became evident, have now become obsolete or so far behind the times as to be unable to furnish a satisfactory service. These same installations under ordinary circumstances, to the uninitiated, apparently give perfectly satisfactory results, and the question is often asked by directors of companies, "Why purchase new machinery when we are filling the bill with the old? We have had a few mishaps, it is true, and the power has been shut off for a short time now and then, but what does it matter if we do stop for a few minutes, or even hours, if we give all that is necessary during the rest of the time?" Now the consumer of the present day when he pays for a thing expects to get it. It is so with the man who is depending on the electric company to light his house or to furnish power to run his shops, as the case may be. It is in nine cases out of ten that the power is shut off at a critical moment; hence it is that these companies with obsolete machinery fail to keep their customers, many of whom feel compelled to install the more isolated plant.

With the introduction of so many of these isolated plants it becomes necessary for the stationary engineer of the present day, who is called upon to take charge of dynamos and motors in connection with his engineering duties, not only to be posted thoroughly as to the care and running of his engine and boilers, but to be somewhat of an electrician as well. Many times he is compelled when he takes a position to run chances of the machinery not getting out of order, and how often is he censured for the apparatus getting out of order when the injunction has been laid against him not to meddle with any portion of the machine or its adjustments. No engineer can take charge of an engine and boiler until he has passed a thorough examination as to his fitness. Still machinery, far more delicate and liable to get out of order is forced upon him. A mischievous person with a little smattering of electricity can give him no end of trouble, when if the engineer thoroughly understands the machinery he could easily locate or determine the cause.

It is not essential that he should cram his head full of the theory of that "mysterious force," but he should endeavor to post himself thoroughly as to the care and running of any electrical apparatus which may be placed under his charge. The modern dynamo is, as a rule, a well built machine, and if proper care be taken should require very little attention; but accidents will happen, and many dollars have been lost through the engineer not knowing what to do in case of an emergency. I will therefore endeavor to give you a few hints as to the care of a dynamo, and an idea of some accidents which are likely to occur, and the best way to look for and repair the same.

To begin with, the position of the dynamo cannot be too well looked after. More often than not, little consequence is attached to this important point, the dynamo being pushed into some dark, out-of-the-way corner, where not only is it next to impossible to see, should anything go wrong, but where it cannot be kept clean. It is most desirable that the position chosen should be in a cool, dry place, free from dust, where the machine can be readily seen and of easy accessibility. This condition is not difficult to fulfill, and the engineer will benefit by it in the end. Plenty of room on all sides should be allowed, as it is not the most pleasant thing in the world to handle in cramped quarters a dynamo which may be running at a high rate of speed and voltage. In choosing a place for a dynamo the switchboard must not be forgotten. It is true that there may be but one switch and fuse block, but it is important to have them where they can both be seen and reached without loss of time. If possible place the switchboard and dynamo where they and the engine can readily be seen from one point, and where in case of emergency, they may be reached with the least possible delay. For instance, if a fuse blows, it ought to be in a position where it would be quickly noticed The chief object in selecting a place for the dynamo which is free from dust, is that dirt is one of the electrician's greatest enemies, and it can safely be said that over fifty of the so-called diseases of dynamos may be attached to this cause. A dynamo, in fact any kind of electrical apparatus, cannot be kept too clean. In cleaning, not merely a general wiping is necessary, but a thorough inspection of every part, for it is the dirt in the out-of-the-way corners which gives the trouble.

Commutator.—In cleaning and inspecting a dynamo, perhaps the most important part to be attended to is the commutator. This, if it has been properly looked after, should have a dark polished surface, and every effort should be made to keep it in this condition. This can only be acquired by cleanliness and proper adjustment and care of the brushes. First—See that no dirt has lodged between the segments, or between the lead wires where they join the commutator bars. A stiff dry brush is useful for this purpose). This is important as many an armature coil has been burned out owing to short-circuiting at the commutator, caused by dirt or copper-dust accumulating at the points mentioned. Secondly—The commutator may be running sparkless and no fear of trouble suggest itself to the engineer; when the machine is stopped, however, careful inspection may show signs of burning along the bars. This should be remedied at once, for if allowed to remain, the result will be badly sparking brushes and development of flats in the commutator. A fine file should be used to smooth the burnt parts, or if too far gone the commutator should be slightly burned down. This latter practice is nearly always necessary in the case of flats It is difficult to explain just how these flats occur; three or four causes are possible: (*a*) One of the bars may be of softer copper than the rest, and so wear away faster; but this is not likely. (*b*) A partial disconnection in the armature at the part connected to

* Paper read at the meeting of Hamilton No. 2 C.A.S.E., Tuesday night, October 12, 1897, by Percy Domville, of the Westinghouse Company, Hamilton, Ont.

the particular flat bar, will cause a spark at every half revolution, so biting away the bar. The trouble in this case will in all probability be found where the lead wires join the commutator. (*c*) Another cause of flats is a badly balanced armature, which, vibrating badly when running, will cause the brushes to jump and spark, burning away one or more of the segments. If the commutator is a new one, particular attention should be paid to keeping the segments firmly held in position. This can be done by tightening the nut or nuts at the end of the commutator. The commutator should be frequently smoothed with fine sandpaper, and oiled until a finely polished surface is obtained.

As before mentioned, the proper adjustment of the brushes plays an important part in the care of the commutator. There is no part of the dynamo that will give the novice more trouble than the brushes, and here again let me impress upon you the importance of cleanliness. A clean well-trimmed brush, properly adjusted in its holder, screwed down to bear against the commutator with just sufficient force to prevent jumping and consequent sparking, and yet not so hard as to cause excessive wear, should give little trouble, provided the commutator is in good condition. See then that each brush is properly trimmed; that is, cut square across, and if copper, filed off at the proper bevel. If carbon, the brushes should first be placed in the brush holders, and a coarse piece of sandpaper inserted between them and the commutator. Then by rocking the rocker arm, the brushes are worn away to the shape of the commutator.

There is no general rule for the thickness of brushes, but one and one half the thickness of the commutator bar is near the mark. The object is to have the brush wide enough to short circuit each section of winding for a brief time, in order that the current may be reversed. The power of the entire machine being dependent of course upon the principle of a rapidly opened and closed circuit creating an induced current, it is much easier to go astray in the thickness of brushes when copper is used, as the angle at which they are set is apt to vary. A very good practice is to make a cross-section of the commutator and brush holder full size in this manner. Then by drawing in the brush, the proper angle can be found, and a piece of wood the shape of the brush can be cut for a template. In adjusting the brushes in the holders, take care that all the leaves, if copper, are in contact the whole width of the brush; if not the result will be a spark, and the longer the machine is allowed to run in this condition the worse it will get This can be prevented by marking the length on your template and making a gauge to set your brushes to. The same care should be taken to see that the brushes bear on precisely opposite bars of the commutator, or, if a four-pole dynamo, that they bear on bars that are a quarter of a circumference apart. A very good way is to mark the commutator bars with a centre punch, so that this adjustment may be verified. Having properly cleaned, trimmed and adjusted the brushes, seeing, of course, that they are all firmly screwed to the holders, they should be raised from the commutator by the hold-off catches and left in this position ready for running.

Outside of the commutator and brushes a general cleaning up is necessary. Remove all traces of dirt from the frame, looking carefully over all insulators of brush holders, binding posts, switches, field coil ends, etc. Also between the armature and pole pieces inside the pulley and around the foundation. Turn the armature round by hand to see that nothing catches and no loose wires or waste are adhering to it, and none of the binding wires are loose. See that the oil cups are full and drip properly. If self-oiling, see that the oil wells are full. Then, seeing that all terminals are screwed down tight, the dynamo is ready to run. Just a word about starting the dynamo. First run your machine with the brushes raised and main switch open, to see that all is right mechanically. Before closing the main switch make sure that the voltage is correct and brushes do not spark. To correct the latter fault, rock the brushes forward or backward till a sparkless place is found; then close the main switch. I might here mention that it is also important to see that all dirt is removed from the switchboard and connections. Examine and clean occasionally the field rheostat contact and contact shoe.

It would take too much time to go into all the details of the mishaps and breakdowns which are likely to happen in the running of a dynamo, but I will mention a few most likely to occur:

Burning Out of Armatures.—It is almost impossible to give any definite rules for the prevention of the burning out of armatures, owing to the probable cause of the trouble being difficult to foresee. Still there are a few points which should be remembered in this connection. As before mentioned, short-circuiting at the commutator is one cause. Burning of insulation under the binding-wires will short-circuit the conductors. Short-circuiting in the armature itself is another cause which cannot be foreseen. All that can be done is to let the coil burn out and repair it afterwards. In drum armatures, and in those forms of ring armatures, which are so connected that the windings cross one another, this evil may occur in consequence of the abrasion of the insulation. Short-circuit between an imperfectly insulated wire and the iron core beneath it is again a fruitful source of trouble.

Field Magnet Coils.—As a rule field magnet coils give little trouble, but when they do the difficulty is hard to locate, owing to their compactness. Disconnections and short-circuits are most common. When there is a disconnection the machine will probably refuse to excite itself. To make sure, the coils should be disconnected at the ends and tested. A common electric bell will tell you if the wire is continuous. If the wire is broken below the surface, the only way to get at it is to unwind it. A short-circuit between any two of the windings will have the effect of keeping the short-circuiting part cool, whilst the rest is hot. The coil may be short-circuited on the frame, which can be tested with the bell.

Sparking Brushes.—Any of the following will cause sparking brushes: Copper or carbon dust between sections of commutator; copper or carbon dust, or oily matter on brush-holders, causing leak to frame; open circuit in armature, overload, brushes not at neutral point; brushes covering too many segments; brushes not making good contact or loose in brush-holder; flats in commutator; too weak a field wire of armature touching pole pieces.

A dynamo that has been giving little trouble suddenly ceases to generate. On examination everything is apparently in good order, and yet it is impossible to get a spark from it. First look for an open circuit. This may be done with the electric bell, although it is not always a sure test, as a ring may be obtained when a wire is broken and held together only by insulation. Here dirt may play an important part. Look closely for it under the coupling screws, binding posts, and between the brush-holder and brush-holder rod. A very small particle may be responsible, as the following will show: An arc-lighting dynamo ceased to generate in the manner mentioned. By short-circuiting the brushes it was found possible to obtain a flash, while outside of the brushes this was impossible. It was plain, then, where the trouble lay. The brush-holder had already been examined, but on again looking, one of the insulators was found to be charred close to the rod for about an eighth of an inch. This was caused by dirt lodging between the insulators and brush-holder. It was little, but enough to grind the brush-holder on the frame. Other causes for machines failing to generate are explained as follows: A dynamo standing idle for some time may fail to light when wanted, through a wire in the field circuit being broken and held together only by insulation; or after the connections have been taken apart for the purpose of cleaning and put together again, trouble has been caused through crossing connections to the field. An expert leaves an engineer in charge of an arc machine, and is called back without loss of time, as the machine will not work, and he finds the switch open in the field circuit. When closed, the trouble ceases—in this case the trouble being caused by a matter so trifling as to escape the mind of the instructor.

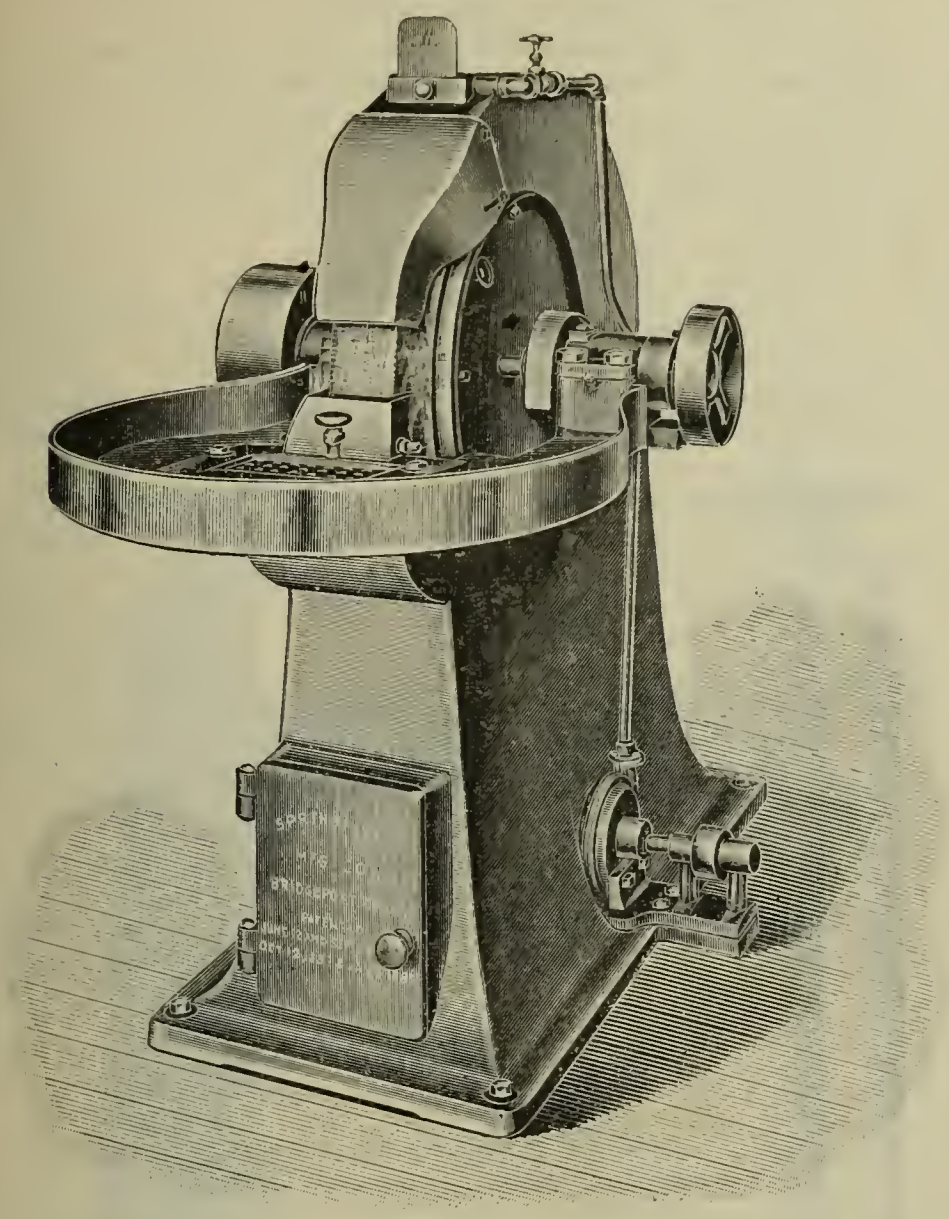
During a thunder storm a flash was noticed at a dynamo, following a vivid flash of lightning, and immediately all lights went out. The dynamo field refused to generate, giving the engineer in charge the mistaken idea that it was burnt out. On investigation it was found that the flash had been caused by one of the binding posts short-circuiting on the frame, the result of lightning striking the line. An engineer after cleaning the brushes of a dynamo could not obtain a spark from it. He had forgotten to screw the lower brushes against the commutator. Another, after hunting for a long time, took the cover off the fuse block and found the fuse blown. These experiences, likely to be met with at any time, with any dynamo, are worth remembering. These are a few of those difficulties which will come to everyone in the responsible position of electrical engineer. There are many points about every machine which should be carefully watched, and faults to be remedied before they become serious There is much than can be gained by experience, but a conscientious worker giving all his mind to his duties, will find himself the gainer, for each day's experience will teach some new point, and what is learned in this way is not soon forgotten.

THE DAVIS BOILER.

The Davis boiler was fully described in THE CANADIAN ENGINEER for June, 1896. This boiler has been put in several boats, with such results that the builders say there is no better boiler on the market. They are tested to 400 lbs. cold water. The great merit of this boiler over other similar boilers is, that there are pots on both sides of the fire, each pot holding one gallon of water close to the hottest fire. There is a strong prejudice against pipe boilers in Canada; but it is fast disappearing as they become better made and better known. The demand for them is increasing yearly, and the British Government is now using them in naval construction.

TOOL GRINDER.

The above cut represents a tool grinder using a 36 x 4-inch emery wheel. This machine is used for sharpening tools, and has many advantages over an ordinary grindstone. It occupies less space; the men stand nearer the wheel, and are thus enabled to do better work, the apron being sufficiently large and deep to keep the water from the floor. An iron tank, easily reached, is placed under the wheel to receive the water coming from it and catch the waste ground off, which settles to the bottom, and when sufficient collects the tank can be



quickly emptied. The water overflows from this tank comparatively clean into a second tank, to which a centrifugal pump is attached and piped to carry the water to the wheel, where a valve regulates the flow to the desired amount; the pump, being piped to the latter, leaves the first tank free from pipe connections, so it can be easily handled. This is an important feature. The emery wheel is surrounded by a floating hood, except where the grinding is done, which prevents the water flying off, and is quickly adjusted to the wheel as the latter wears away. Water is carried by a small iron pipe, and evenly distributed on the wheel. Weight of the machine, about 2,250 lbs; height from floor to centre of spindle, 36 inches; length of self-oiling bearings, 8 inches; diameter of spindle, 2¾ inches; spindle pulley, 12 x 5½ inches; floor space, 24 x 48; driving pulley on countershaft, 16 x 5½ inches; speed of emery wheel, 375 to 425 revolutions per minute. Similar machines are manufactured with the following size wheels: 12 x 2; 14 x 2½; 20 x 3; 26 x 4, and 30 x 4. These machines are constructed with safety collars and special wheels with large holes, which make the price of the wheel nearly as cheap as an ordinary grindstone. The Springfield Mfg. Co., Bridgeport, Conn., special tool makers, are the manufacturers of this machine, and will be pleased to furnish further information.

STREET PAVING IN TORONTO.

The change in the popular mind in regard to paving materials is shown by the rise and fall of the cedar block in Toronto and the present popularity of brick. The city engineer's report, just issued, contains a number of interesting tables. The present percentage of the various classes of pavements is as follows:—

	Per Cent.
Cedar block	42.23
Stone and scoria	.31
Asphalt	5.67
Wood on concrete	.21
Macadam	15.43
Unpaved	30.98
Cedar block with asphalt between tracks	2.47
Cedar block with brick between tracks	1.92
Macadam with stone sets between tracks	27
Brick on concrete	51
	100.00
Total	257.40 miles

In 1881 there were only 116.85 miles of streets in Toronto, and of this total 63.39 miles, or over half, had no pavement of any sort, were, in fact, mud roads. Of the balance 51 miles were macadamized, and only three and a half miles were paved with cedar blocks, the best material then in use, with the exception of a few feet of stone sets laid as an experiment. In 1882 the cedar block craze began, and the mileage of cedar blocked streets rose to 13.41. This was doubled in 1883, and the increase thereafter till 1891 was extraordinarily rapid. Here are the figures of cedar block mileage in use for those years:

Years.	Miles
1884	33.76
1885	39.84
1886	48.89
1887	64.11
1888	79.55
1889	92.29
1890	109.57
1891	116.83
1892	116.86

Between 1883 and 1890 the mileage of macadam was reduced from 54.27 to 36.63, largely by the tearing up of the latter material to make way for a pavement that is neither so healthy nor of such lasting qualities. The failure of cedar was made plain about 1890 and 1891, and since that time, notwithstanding renewals of block pavements on streets where property could not stand a more expensive pavement, the mileage of cedar paved streets in use has fallen. In 1892 it was 116.86, in 1893 112.19, and in 1896 108.70, while this total has been materially reduced during the present paving season. Asphalt was introduced in 1887, when a small strip was laid on Bay street, between Front and King. Jarvis street was paved next year, and the experience was so satisfactory that the asphalt mileage of streets increased from one-quarter of a mile in 1888 to 14.61 miles in 1896. Some of the streets, like Bay and Jarvis, laid almost ten years ago, are still in splendid condition, and will last a long time yet without renewal of the wearing surface. Macadam is again being laid extensively, the mileage having increased from 34.98 in 1893 to 39.71 in 1896. Vitrified brick for paving between the street railway tracks was introduced in 1893, and some five miles of it is now in use. As a material for the full width of the street it was introduced in 1895, and about a mile and a half was in use at the end of 1896. It is now being laid very extensively on gravel foundations on residential streets. The general position of affairs will best be shown by comparing in miles the amount of each of the leading materials in use in five year periods since 1881:—

	1881.	1886.	1891.	1896.
Cedar	3.51	48.99	116.83	108.70
Asphalt	....	....	6.66	14.61
Macadam	50.92	47.36	36.39	39.71
Brick	....	....	....	1.32

AN ISOLATED SEWAGE DISPOSAL PLANT.

(From a Correspondent)

The summer hotel at Penetanguishene is situated on the foreshore of an arm of the Georgian Bay, and is equipped with the latest and best sanitary appliances, including a sewage disposal works, containing several of the latest improvements in the sewage filtration. What these new departures in sewage treatment are, is fully explained in an article on sewage disposal commencing on page 128 of the September number of THE CANADIAN ENGINEER.

I am told that often there are as many as 300 boarders, and when that is the case there will be about 4,500 gallons, or 15 gallons per head, per day, of sewage discharged, 95 per cent. of which will be discharged between the hours of 6 a.m. and 8 p.m. This will make the amount of sludge or settlings in the settling tank about 450 lbs. per day, or 1½ lbs. per head, probably reduced to one-half by decomposition. This will have to be removed, though it is composed of 90 per cent. of water and only 10 per cent. of solids. I propose to describe this Penetanguishene sewage works, because there are in it some points that are unique, as well as efficient in their application, and suitable in our climate for the proper working of the system all the year round, if necessary.

At Penetanguishene, only pure domestic sewage from water-closets, baths, basins and dish water is handled; storm or rain water being very properly excluded. Suitable provision is made to extract the grease from the dish and washing water discharged from the kitchens before it comes to the junction where the waste pipes con-

nect with the main drain. This is a very important and useful arrangement, because grease destroys the efficiency of drains and sewage disposal works. See remarks on the subject of grease, on column two, page 129 of the September number. After the sewage from all parts has been gathered together, it is discharged into a 350-gallon settling tank. (This is somewhat too small for so many people.) This tank has a discharge pipe in the centre, enabling the sludge to be drawn out into a barrel or wagon that may be so constructed that no offensive smell can be observed. When the hotel is working at its full capacity a half ton of sludge may need drawing out every week, but those taking it out can tell best when the thick sludge is drawn off. It is a great detriment to the working of this disposal works that the settling tank is compelled to be so near the house, which causes the paper and excrement from the w. c. to enter it without any chemical change or decomposition having begun, and the process of dissolving paper and excrement into a liquid has to commence in the settling tank, in place of the drains, which is generally done in town's sewage. On sanitary grounds, it would also be unwise to use screens or sieves before entering the tank, because they would catch all the solids just as they are discharged, and the screens would be rapidly choked, and be very offensive to empty and clean.

To overcome this difficulty the whole is allowed to drop into the settling tank, and to prevent it accumulating in one place or becoming a solid mass, a couple of rakes are connected to a central shaft which can be turned round and thus agitate the mass, causing it to more easily dissolve. Of course the stirring should only be done the very last thing of any night, so that the sludge will have time to settle before much of it can overflow into the syphon tank, and never less than four hours prior to opening the valve to run the sludge out, because in that case only very watery sludge could be drawn. From the settling tank the clear sewage is overflowed into a syphon tank which discharges its contents over on to the irrigation filter every time the quantity accumulates to the amount of 400 gallons.

The sewage when discharged from the syphon enters a conduit 87½ feet long which runs the whole length of the irrigation filter, having a branch pipe on each side every two feet, which thoroughly distributes the cleared sewage equally over the surface of the filter. At the bottom of the filter bed there is a similar set of drains to collect the purified effluent and to convey it into the bay. The conduit and distributing pipes are placed about 15 inches below the surface, carefully buried and covered with gravel and sand, the whole topped with sods, which prevents any smell arising, and if the works were used in winter it would also prevent any injury to the filter from severe frosts. A thorough explanation is given in the September article, showing why and how all filters purify sewage; proving that it is not the filtering material that does the purifying alone, but the microbes and bacteria that lodge in it, and that an ample provision of air should always be made to revivify and aerate all filter beds, so that the microbes can secure plenty of oxygen, and discharge the hydrogen they evolve. Particular attention has been given to this requirement at Penetanguishene, and though the surface of the irrigation filter bed is nearly air-tight, or will be when the sods get well knitted, air flues are so arranged that an abundant supply of atmospheric air can be drawn in as needed.

It will be noted that the flushing machinery discharges 400 gallons every 1¼ hours during the day, and nine hours during the night. It will take about thirty minutes for each flushing to pass down through the sand and gravel filter. When passing down and through the filter it is forcing the air the gravel contains downward before it, and a fresh supply of air follows on after the sewage. Thus, the filter is revivified and aerated after each flush, and after each flush it takes a rest for 45 minutes during the day and 8½ hours between each discharge during the night, which should keep the microbes in a healthy condition and ready to do their work. The filter, or what may be properly called an artificial irrigation land filter, is 85 feet by 40 feet, 377 square yards or about 1¼ yards to clean the sewage from each inhabitant when the hotel contains 300 persons, giving about 12 gallons of sewage per yard per day, which is very easy working, and could be more than doubled with safety. The designer of this artificial land filter, and the arrangements for aeration and revivifying the filter are worthy of commendation, but in any future works of the kind it would be wise to give more space for the settling process, and a little improvement in tank arrangements. Whoever brought forth the idea of distributing the sewage on land below the surface, did a great deal toward solving the difficulty of being able to irrigate land with sewage during hard frost, and of preventing offensive smells from such works in hot weather.

I might also state that the Penetanguishene irrigation filter is high and dry above high water mark, even at its lowest point, and can never be waterlogged or drowned and have its efficiency impaired.

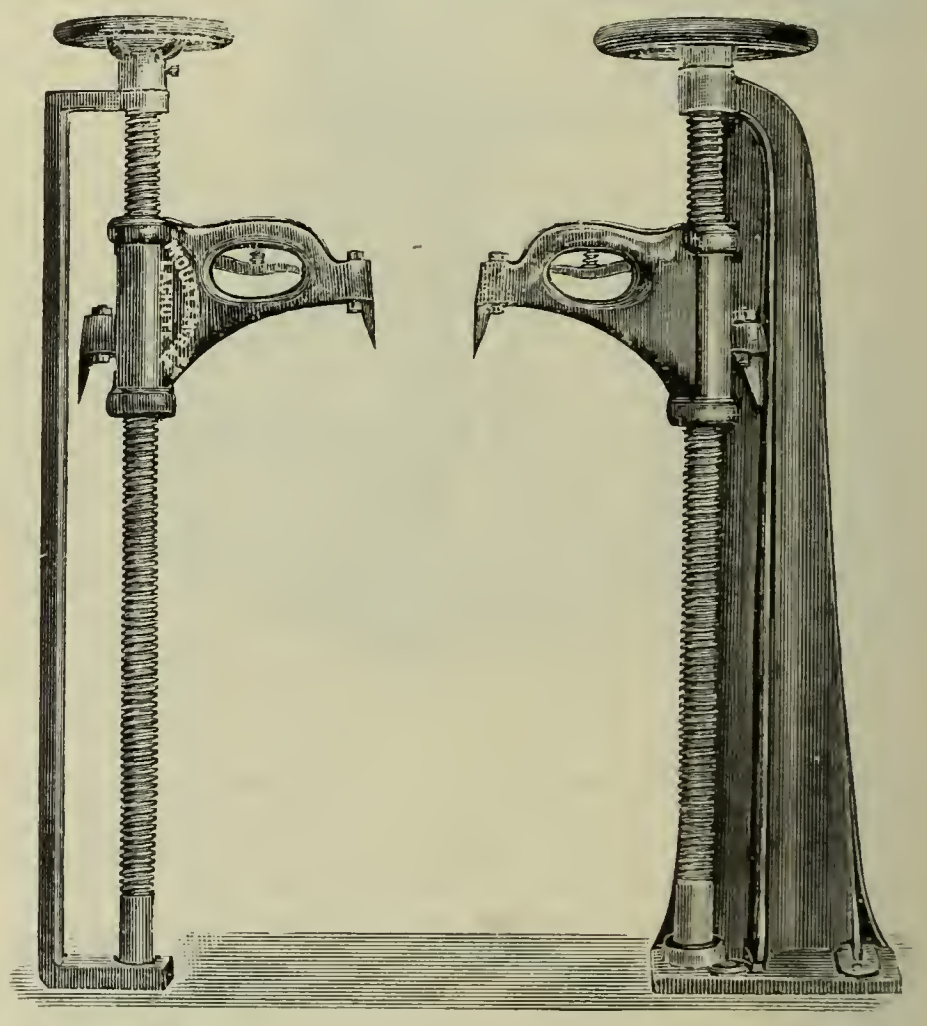
The design and arrangements are a model worth copying by those desiring a sewage system on that principle. At Penetanguishene, the elevation of the hotel being over 20 feet above the water line of the bay, made sewage disposal by irrigation easy; good fall and ventilation could be introduced, but there are few private dwellings or hotels placed in so advantageous a position as this.

The system of distributing the sewage over one foot below the face of the soil was adopted in Great Britain several years ago, for the purpose (so it was stated at the time of introduction), of being able to plough the land without impediment caused by the usual ditches and pipes used to distribute the sewage on top.

Dr. Bryce, Secretary to the Board of Health, in his printed report on the personal inspection of this sewage works at Penetanguishene, dated June 7th, 1897, states that "perhaps the most satisfactory feature of the new improvements is the sewage disposal works. They are an admirable illustration of good engineering and mechanical work applied to carrying out the method of sewage filtration by surface irrigation."

CLIMAX FROST DOG.

An illustration is given herewith of the Climax Frost Dog, designed and patented by the manufacturers, McOuat & McRae, Lachute, Que This dog weighs enough to drive into a log. By pressing a spring the head is detached from the screw, and its own weight



will send it into position in the log. Then by simply pressing a latch, it is instantly released without the use of a hammer. The advantages of these points are manifest to every sawmill man, and no other frost dog will accomplish these results.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The first meeting of the season of the Canadian Society of Civil Engineers, was held Oct. 14th, W. J. Sproule in the chair. The secretary reported a number of applications for admission and for transfer, which had been considered by the council and classified. It was also announced that the society had agreed to lease the new premises from the Bank of Montreal The discussion on Willis Chipman's paper on the Separate System of Sewerage in Ontario, was then opened, Messrs. Van Buskirk, Ardagh, Bowman and Chipman taking part in the discussion. A paper on Fortifications, by C. R. F. Coutlee, was then read, and an informal discussion on the necessity of military training in our engineering schools was held, after which it was moved by Wm. McNab and seconded by C. H. McLeod, that the thanks of the society be tendered to Mr. Coutlee for his interesting paper on Fortifications. The meeting was then adjourned.

At the meeting of the society on October 28th, J. A Waddell, consulting engineer of the Kansas City, Pittsburgh and Guelph Railway, and permanent engineer of the Omaha Bridge and Tramway Company, gave a lecture on the subject of "Bridges." This was a continuation of the lectures given last year to the students of applied science at McGill University, and all of them are chapters of a book which is to be published next January. We must not forestall the book by quoting

verbatim the really valuable matter which it will contain. In THE CANADIAN ENGINEER of November last, however, we gave a few hints of Mr. Waddell's contentions for greater beauty in construction, and a few specifications of bridges which he had already constructed. The lecture before the Civil Engineers' Society was on "Cantilever Bridges and the Designing of Piers." He objected to the general though false notion that cantilever bridges were always economical, and gave a complete list of the numerous stresses which have to be calculated upon. Instances were found in the bridges either erected or to be erected in Japan by Mr. Waddell. Some advice as to anchorages followed, and then some criticism on the largest cantilever bridges in the world, namely, the Queen's Ferry in Scotland; Lansdowne bridge over the Indus, India; railway bridge at Memphis over the Mississippi, and the Red Rock bridge over the Colorado River. The lecturer then treated of how to design the best piers for different kinds of crossing, and how to proportion them, with criticisms on the cofferdam, pneumatic and open dredging processes. These lectures are taken up largely with elaborate calculations and masses of data, which, when published, will make a most valuable reference book, and probably save days of original figuring to very many bridge designers.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The following is a corrected list of the officers of the C.A.S.E., No. 9, Berlin, Ont.: Wm. Oelschlager, past president; Geo. Steinnetz, president; Job Heyd, vice-president; W. J. Rhodes, secretary; Wm. Tiedt, treasurer; J. L. Bowman, conductor; Agt. Prizgodda, doorkeeper: S. Erglert, A. Arndt, A. Sararas, trustees. Meetings every Friday evening.

Hamilton Association, No. 2, C.A.S.E., are holding open meetings of instruction, two meetings each month, for the fall and winter, to which the public are invited through the press.

The annual dinner of Toronto branch C.A.S.E. will be held on the evening of 24th November at the Richardson House.

Toronto Association of Stationary Engineers is having open meetings on the third Wednesday of each month at its hall, 61 Victoria street, and invites all engineers and manufacturers. This month a lecture on the "Construction of Boilers," by the well-known boiler maker, J. J. Main. All are welcome.

FIRES OF THE MONTH.

Oct. 4th.—E. C. Squire's cheese factory, Norwood, Ont. Loss on building and machinery, fully insured, $1,200.——Oct. 5th.—Smith & Elford's brick yard, Victoria, B.C., $2,500 damages.——Oct. 7th.—The Edwards Trading Co., Limited, Thurso, Que., lost heavily in the fire at South Indian, Cheney, and Racine, Ont. The total losses amount to about $30,000, a good deal of which was insured. This includes 600 cords of wood at South Indian, 400 cords at Cheney, 100 cords at Racine siding, a sawmill and planing mill and a shingle mill, 300,000 feet of lumber, 800,000 shingles. Total insurance $10,000.——Oct. 9th—Dominion Elevator Co.'s elevator, at Bagot, Man.——Oct. 13th—F. J. McManus' sawmill, Bathurst Village, N.B. Loss, about $3,000.— Oct. 14th—Bleach and Boiler Room of the Northumberland Paper and Electric Co, Campbellford, Ont. Loss was large.——Oct. 14th—Spoolwood mill, at Sugary, N.B.——Oct. 19th—Kingsville, Ont., business block, including A. G. Adams' hardware. Loss, $4,000; H. Scratch, bicycles, $2,500.——Oct. 19th—Philp & Eckhardt's Factory, Esplanade street, Toronto. Loss, $15,000.——Oct. 20th—R. Metzler's Cheese Factory between Violet and Wilton, near Belleville, Ont. Loss, about $6,000.——Oct. 26th—Verity Plow Co., Brantford, Ont. Loss, $25,000.

"THE Electrician" Electrical Trades' Directory and Handbook for 1898 (the big blue book), corrected to January, 1898, containing a very carefully compiled list of British, colonial and foreign electricians, electrical engineers, electric light engineers and contractors, electrical apparatus makers, plant and machinery builders, instrument makers, electric bell makers and fitters, electric light, telegraph and telephone companies, electric light, telegraph and telephone engineers, wire makers and drawers, and of all persons engaged in electrical pursuits throughout the world; useful tables and data relating to electric light and traction, electric power transmission, telegraphs and telephones, electricity supply companies, home and foreign Government departments, etc., etc.; and a biographical section, giving interesting particulars of the careers of about 305 eminent men connected with electricity in all its applications, with many portraits. Full particulars will be sent immediately on application to *The Electrician* office, Salisbury Court, Fleet street, London, E.C. This valuable work will be issued January 1st, 1898.

Mining Matters.

A STRIKE of gold-bearing rock is reported on the farm of Ira Swayze, a few miles east of Jordan, Ont.

THE Ontario Government is now completing the road into the Saw Bill district as far as Saw Bill Lake.

ROBERT WERDEN, Picton, Ont., has discovered a deposit of tourmalin in one of the northern townships of the county.

TH. Harvey Hill Copper Mine, Megantic County, Quebec, has not closed down as was stated in our October number.

THE American Asbestos Company has sold its Black Lake, Que., mine, to L. & E. Wertheim, Frankfort, Germany, for $14,900.

J. C. GARVIN, Denver, Colo., proposes to use a bromide process in treating the black sand in the Saskatchewan, near Edmonton, N.W.T.

THE Toronto Technical School is putting in assay furnaces, intending to give instruction in mining processes during the coming winter.

THE mill at the Golden Cache Mine, B.C., will be run during November, and a clean up made at the end of the month to determine the value of the mine.

E. C. ROSENZI, of the Canadian-American Oil and Natural Gas Co., is preparing to make extensive borings for oil in Ontario, in the neighborhood of Belleville.

THE Rothschilds, of London, England, are reported to have made an offer of two million dollars for the Sultana and Ophir gold mining properties, near Rat Portage, Ont.

E. MCCONNEL has had men recently up above Lake Temiscamingue testing a new find of gold, and has every reason to hope, from tests made, that it will turn out to be a rich find.

THE Ruth mines, Sandon, B.C., will, it is said, put in a concentrator, and the Slocan Star Company has surveyed a site at Cody for one to treat the ore from their Noonday property.

A PLANT has just been installed by the Canadian Rand Drill Co., Montreal, at Bruce Mines, Ontario, and it is hoped that such is an indication of a revival of the mining industry in that section.

J. C. Ross, Pleasant Harbor, N.S., is doing extensive development work on a very promising property, at Tangier, N.S., which was formerly owned by the Pittsburg and Nova Scotia Gold Mining Co.

THE copper-bearing properties in the neighborhood of Kaladar, Ont., are in demand. I. M. McMaster, Rochester, N.Y., is purchasing locations. He has bargained for John A. Carscallen's mine near Flinton, Ont., for $1,500.

THE large compressed air plant, recently installed by the Canadian Rand Drill Co., Montreal, at the new pit of the old Sydney, C.B., mines, has been started and put into service. The machine is of their standard duplex type of the latest pattern.

AT Antigonish, N.S., there has recently arrived a new plant purchased from the Canadian Rand Drill Co. for the Purvis property. The compressor is of the modern duplex type. It is expected that within a few days this will be in active operation.

F. C. INNES, of the Fern mine, Nelson, B.C., stated recently that the new ten-stamp mill was working perfectly, and the percentage of saving and amount of ore treated was greater than calculated upon. The foundation for ten extra stamps is in position.

W. H. MCNEIL, managing director of the Anthracite Coal Company, stated recently that the Canmore, N.W.T., mines are now being opened and turning out 1,000 tons per month, and the capacity of anthracite mines will shortly be 3,000 tons per month.

W. A. FRASER, manager of the Government oil-boring operations at Victoria, N.W.T., has closed operations for the season. A depth of 700 feet has been reached at Victoria, with a slight flow of gas. At Pelican rapids on the Athabasca River there are good indications of oil at 820 feet.

GOLD has been found in paying quantities in the ore dumps of the silver-lead Highlander and Highland mines at Ainsworth, B.C. Maxwell Stevenson, manager of the Highlander, has received returns of $29.70 per ton in gold, from assays made at the United States assay office at Charlotte, N.C.

ONE of the most modern compressors of its size that has ever been in Nova Scotia, was forwarded by the Canadian Rand Drill Co., the other day, to H. H. Fuller & Co., of Halifax. The machine is designed for both mining and high pressures, the air cylinders being compounded and worked in conjunction with an intercooler of the latest type. The heads of the machine were of the hooded type, which renders the compressor in operation practically noiseless.

J. W. TYRRELL, the engineer, Hamilton, Ont., has just returned from the interior of Northern Ontario, east of Lake Winnipeg, which is known as the Lac Seul country, where he has been examining some mining properties for an English company. Gold was found, it is said, in considerable quantities.

A TEST of the gravel taken up by the dredge employed in clearing out the ground for the middle pier of the bridge, at Edmonton, N.W.T., showed a very large prospect of platinum and a moderate showing of gold. This is said to be the first attempt at prospecting for gold in the bed of the Saskatchewan River.

THE large plant which has just been installed by the Canadian Rand Drill Co., Montreal, at the Sultana property, is about ready to start. The mill, which contains 30 stamps, is already in place, and it is expected that the whole will be working very shortly now. Mr. Ross, the local engineer for the Rand drill people, has just returned from there.

THERE is considerable activity in mining in the neighborhood of Thessalon, Ont. A party of wealthy Americans have bonded one of the large properties and contracted with the Canadian Rand Drill Co., Montreal, to install a complete mining plant. They are going at the matter in earnest and have a large force of men on the ground. The machinery is already there and being set up.

FLORENCE, Middlesex, Ont., is now attracting a great deal of attention as an oil field. The development was only begun in September, but already a very successful well is being pumped, as we show in another column. Very little can be ascertained as to the actual flow at the well, but from the machinery being purchased, and the confident air of the owners, there can be no doubt of the value of the field.

AFTER a great deal of difficulty the heavy compressor and the two immense boilers shipped some time ago by the Canadian Rand Drill Co. to the Foley Mines have arrived in safety. William Brown, erecting engineer for the Rand Co., is hard at work with several gangs of men laying pipe lines and pushing forward to completion the plant, so that it may be started up within a few days now. The compressor is of the modern type, with compound cylinders, condenser, and other modern and economical appliances.

AT the Mikado Mine back of Rat Portage, all is activity, and preparations are being made for a new plant, lately contracted for with the Canadian Rand Drill Co., through their Rat Portage engineer, Mr. Ross. The plant is to consist of one of Rand latest type duplex compressors, and with a complete equipment of boilers, air receivers, drills and other accessories. The plant will be shipped within a few days now, and transportation arrangements are being made for its delivery at the mine.

WORD has just been received by the Canadian Rand Drill Co., to the effect that the guarantee on the large stamp mill erected at the Crystal Mine has in every way been fulfilled, in fact the machinery throughout has been found to surpass in every way contract specifications. The contract called for a complete equipment, from the supplying of plans for the building, to the starting and operating of the mill for thirty days. Since this a hoisting plant has been ordered and is in daily operation.

WHILE great stories of the Klondyke are abroad, Nova Scotia is not behind. Within the last month large gold finds have been made in various localities. In Guysboro a new find, 17 feet from the surface, gave from one shot $1,000. Capt. William McKenzie, who was down to Renfrew, N.S., last week, reports a great find, 8 feet from the surface, from 18 buckets of which $6,000 was taken, being the work of only three or four days. Two young men were the lucky finders.—*Colonial Standard, Pictou, N.S.*

AT River Herbert, N.S., the annual meeting of the Boston Coal Mining Company (Limited) was held at the mines of the company. The following officers were elected: H. C. Whitney, president; J. Needham, secretary and treasurer; J. E. Blackemore, W. H. Baker and John C. Gordon. The increase of the capital to $1,000,000 was confirmed. The union of the Lawrence and the Victoria areas will give an opportunity to follow the veins of coal worked on the Lawrence area into the Victoria property, which has never been worked.

A RECENT despatch from Gaspe, Que., stating that the Petroleum Oil Trust Co. had shut down their operations and abandoned their works, was calculated to create the impression that the whole enterprise was a failure. It appears, however, that this is not the case. The Petroleum Oil Trust Co. is an English company, which has expended a large sum of money borrowed in England, France and Belgium, at least $750,000, it is said. What has led to the erroneous impression prevailing on the subject, is the way in which oil boring operations are carried on. The company has sunk a large number of wells on its lots in Gaspe, which represent a superficies of 100,000 square acres, but the borings were stopped the minute the presence of [illegible] pipes closed and sealed.

E. TAILLON, Eganville, Ont., has found a silver mine on the Opeongo River.

THE latest discovery of gold in Quebec is reported on the farm of Lewis Cuthbertson, Clarendon Front, Pontiac county.

MINING is being somewhat vigorously pushed at Shawville, Que., by a Belgian and American syndicate. A good quality of zinc ore is being taken out.

IT is said that J. A Caldwell the owner of the Sultana mine, Lake of the Woods, Ont., recovered $34,800 in gold by burning the sluices, traps and flooring of the old stamp mill.

A DIAMOND drill has arrived at Dunsinane to bore in the coal mine. If the seam is thick enough to pay for working, the company will start operations soon, as the coal is of very fine quality.—*Sussex, N B., Record.*

W. H. WYLIE, formerly manager of the gold mines at Marmora, Ont., is now the expert of the Great Northern Mining Company, and recently was sent to test a gold field at Lake Wawa, Ont, which assayed $692 to the ton.

THE deposits of barytes near Whycocomah, C.B., are attracting considerable attention. This summer we learn that Henderson & Potts, who own several good properties there, have taken out 450 tons for use in the manufacture of paints.

A NUMBER of Canadian students are entering the Michigan College of Mines, in spite of the high fees charged non-resident pupils. A matriculation fee of $25 and an annual fee of $150 is now collected. The session of the Michigan Legislature for 1897 changed the name of the Michigan Mining School to that of the Michigan College of Mines.

THE Dominion Coal Company has contracted to ship 2,000 tons of duff coal to the Ferrona Iron Works in Pictou county, N.S., for experimental purposes in the manufacture of coke, and particularly to ascertain whether or no the Cape Breton coals contain too much sulphur for this purpose. Dominion, Reserve and Caledonia coals will be used for these experiments.

THE River Gilbert in Beauce County, Que., is attracting some notice lately as a gold field. In 1889, the Provincial Mining Engineer Obalski, reported that the quantity of gold in the old bed of the river was $50,000 to $100,000. Hitherto, it is said, the chief difficulty in working the property has been the matter of land titles, but this has been settled by a recent judgment

THE directors of the Crow's Nest Pass Coal Co., capital $100,000, are: Clarkson Jones, F. Wyld, Toronto; G. Gillies, Gananoque, Ont.; Wm. T. Jennings, C.E.; B. Jennings, ; Geo. Elliott Casey, Fingal, S. F. McKinnon, W. Mackenzie, J. Flett, J. G. Jones, W. R. Brock, Toronto; C. J. Miles, Hamilton; J. J. Kingsmill, Toronto; D. D. Mann, Montreal ; J. Sutherland, Woodstock.

H. N. KITTSON, Hamilton, and H. A. Wiley, Port Arthur, about the middle of last month, brought three gold bricks from the Saw Bill mine. The bricks combined weigh 180 ounces and are valued at $3,800. They are the result of the first clean-up at the mine. During the twelve-day run of the mill about 250 tons of ore were crushed, which means that from every ton over $15 has been saved in the batteries, and on the plates. When the concentrates, which are rich, come to be treated, the ore will run at least $17 to the ton. The next clean-up took place about Nov. 1st. The company have already about 2,500 tons of ore on the dump, and between 25,000 and 30,000 tons blocked out in the workings. In other words there is already in sight, at this rate of calculation, nearly $500,000.

Railway Matters.

THE first hundred miles of the Crow's Nest Pass Railway will be completed by December 1st.

T. D CARROLL & Co., have a contract on the Ottawa and New York Railway, at South Finch.

THE first rail on the Atlantic and Lake Superior Railway was laid at New Carlisle, Que., October 25th.

THE Drummond County Railway was formally opened from St. Hyacinthe to Chaudiere, Que., October 22nd.

SIR WM. VAN HORN recently stated that the C.P.R. would build a line from Robson to Rossland, B.C., 28 miles.

THE last rail on the railroad across Newfoundland being built by R. G. Reid, was laid Oct. 2nd, at Port au Basques.

CAPT. MCMILLAN, of the steamer "Princess," has accepted a position with the bridge company building the O. & N. Y. Ry. bridge.

THE Canadian Pacific Railway has placed two corps of surveyors on the road with a view to open up the Stickeen River route to the Yukon,

C. J. Pusey, president of the Irondale, Bancroft and Ottawa Ralway, has made arrangements by which he will complete an additional five miles of road this fall.

The grades on the Crow's Nest Pass railway in no case will exceed one in one hundred which will make it the easiest crossing of the Rockies in existence.

Alex. McDougall, Arnprior, with a staff of twenty-five men—blacksmiths, clerks, timbermen and teamsters, has a contract on the construction of the Crow's Nest Pass Railway.

Wm. MacKenzie, Toronto, and D D. Mann, Montreal, have bought the Vancouver, Victoria and Eastern Railway charter. The charter covers the line from Vancouver, through Boundary Creek and Rossland.

The Central Vermont Railway has passed under the control of the Grand Trunk Railway. It comprises about 700 miles of road, from St. Johns, Que., to White River Junction, Vermont, and the line to New London.

Wm. Gibson, Beamsville, Ont., is making rapid progress on the masonry of the reconstructed Victoria Bridge at Montreal. Very little false work has been found necessary, as the materials are run out on cars on a track on top of the covering of the old bridge.

At the semi annual meeting of the stockholders of the Grand Trunk Railroad of Canada, held Oct. 14th, in London, Sir Charles Rivers Wilson, president of the road, congratulated the stockholders on the announcement that the accounts showed a surplus of $13,540.

It is rumored that the C.P.R. is to be extended west from Reston into the Pipestone country. A Souris, Man , correspondent writes that a Government official has been directed to make a thorough inspection of the country west of Reston, and make a report on it.

A new private car for the use of F. H. McGuigan, general superintendent of the Grand Trunk Railway, has been turned out of the company's shops. The car is fitted with all of the latest improvements and is handsomely finished in oak. It will be known as the St. Lawrence.

The Grand Trunk Railway system has added another official to its staff, W. J. Shannon, who for some time past has been travelling over the road instructing the train hands in the proper use of the air brakes. He will be known in the future as the acting air-brake inspector of the entire G.T.R. System.

Angus R. Maclennan has the contract for the grading of the first section north of Cornwall, Ont., on the Ottawa and New York Railway. Green & Butler, of St. Catharines, have the second section, and P. Bonneville, of Lancaster, the third. Charles McGill, Dixons, has a section of the grading. D. R. McDonald, of Williamstown, has taken a contract for twelve miles of the grading north of Crysler.

Engineer L. L. Buck, designer and chief engineer of the new steel arch bridge to replace the suspension bridge at Niagara Falls, says the superstructure will be well under way by November 10th. The false work is almost complete, and the abutments are ready for the superstructure. As mentioned in a recent issue of The Canadian Engineer, it is the intention on the completion of the bridge to take down the old suspension bridge and erect it at Queenston, Ont., thus making a belt line possible on the electric railways.

Amongst the contracts recently taken by Paquet & Fortin, Levis, Que., according to the Quebec *Chronicle*, are a railway branch for the Laurentide Pulp Company a mile and a half in length, and west of the St. Maurice River, which is to be completed at once; a branch of the Great Northern Railway, ten miles in length, to the north of Three Rivers, and a bridge over the Shawenegan River, at five miles and a half from the Grande Mere bridge. It is to be 370 feet in length and 85 feet high. The superstructure is to be of steel, and is being made by the Dominion Bridge Company. They are also building three miles of railway and track to reach the place called Coulee Lavergue, and three miles further up than the Shawenegan River; also a steel bridge 500 feet long and 92 feet high, to be erected over a branch of the Shawenegan. Some 600 men are employed on these works.

—The largest elevator contract on record is that recently awarded to the Sprague Electric Elevator Co., of New York, by the new Central London Railway, which will run underground through the heart of the great English metropolis. There are to be forty-nine elevators erected in twenty-five different shafts and distributed over six miles of route. The minimum lift will be forty-one feet, and the maximum ninety-one and a half, and they will have an average capacity of one hundred passengers each. This company is represented in Canada by Jack & Robertson, St. Helen street, Montreal.

Marine News.

The Richelieu & Ontario Navigation Company declared a per cent. half-yearly dividend at a meeting, Oct. 11th

John White, Arnprior, has launched a boat fitted with a gas engine from the works of J. R. Baird, Woodstock, Ont

J H. Wood and S B McNeil, Pembroke, Ont , have gone into business as boat builders at Athabasca Landing, N W T

Poole Bros., Yarmouth, N S , are building a steamer 80 feet keel, 90 feet over all and about 70 tons register She will be fitted with steeple compound surface condensing engine and steel boiler, by the Burrell-Johnson Co , Yarmouth.

Wm. Thomson & Co., St. John, N B , have contracted for a new steamer with Russell & Co., of Port Glasgow. This boat will be delivered in January next, and will be about 2,000 tons net register, carrying 5,000 tons dead weight. The boat will be called the "Arbela"

The Bertram Engine Works Company, Limited, has contracts enough on hand to keep it employed for two years, and this press of business expedited the withdrawal of George H Bertram, president of the company, from the firm of Bertram & Co , hardware merchants

The Rockland, Me., Shipping Co. has sold the three schooners, "Enterprise," "Emperor," and "Fanny G.," to a syndicate composed of business men of Digby and Yarmouth, N S. The vessels will be used in the carrying trade between Digby, Yarmouth, Boston and New York.

Louis Coste, Chief Engineer of Public Works, has written to Hon. Robert Watson, Commissioner of Public Works in Manitoba, informing him that tenders will shortly be asked for works designed to lower the waters of Lake Manitoba, a scheme for which Parliament appropriated $25,000 last session.

The side of the Soulanges Canal for a distance of 1,300 feet, and to a depth of 70 feet, fell in recently, carrying with it three large piers and doing damage which may reach $100,000. The accident happened in the night, and there is, therefore, no loss of life The cave-in happened at what is known as the Raynor section, just above the Coteau du Lac, and at a point where the contractors were at work building a bridge.

The Grand Trunk Railway, with most commendable enterprise, has arranged for a very considerable extension of the tonnage sailing from Portland, Me., in connection with its line. There will be a monthly service between Hamburg and Portland by the Hamburg-American Co., a weekly service to London and a fortnightly service to Bristol and Glasgow. This will make an addition of 60 per cent. to the tonnage serving the G.T R. at Portland, Me. The service will begin November 15th.

Mr. Lacouture, ex-M P.P. for Richelieu, has organized two companies for the colonization of the Lake Temiscamingue region. One of the two companies has in view navigation on the lake, and will construct two boats during the winter. The other company has for its object the building of mills and the general development of trade and industry. Mr. Lacouture leaves this evening for the lake with a number of new settlers, several of whom are former Government employees whose services have been dispensed with.

St. John, N.B , papers outline great wharf improvements there to accommodate the C.P.R. The plan deals with what is known as the Long Wharf, and is to extend the present wharf 60 feet south to the harbor line, and carry it back a distance of 700 feet from the southern end, dredging a channel on each side to a depth of 30 feet, making a total of 1,400 feet wharf facing, without including the southern end, which is less than 300 feet long. The tracks to the Union depot are to be moved toward Main street to a point beyond where the wharf is to terminate. The old mill will be torn down and a grain elevator erected in the centre of the wharf. The capacity of this is to be 750,000 bushels.

A new syndicate, with a capital of $30,000, is being formed, it is said, at Montreal for the purpose of purchasing a steamer specially for pilgrimages and excursions. The new boat will have a speed of nineteen or twenty miles an hour. She will be fitted with 128 staterooms, having from two to three berths in each, and will be licensed to carry 800 passengers. The boat will ply to Ste. Anne de Beaupre from Montreal and other points, with pilgrimages and excursions only. It is also said that there will also be another syndicate formed for the purpose of acquiring two steamers to run between Montreal and Quebec to connect with the American line from Lake Ontario, and a new line which is to run on the Saguenay route between Quebec and Lake St. John

Electric Flashes.

THE electric railway in Sherbrooke, Que., and Lennoxville, is now completed into the centre of the latter town.

THE Canadian General Electric Company is installing an isolated direct current plant for the Raymond Mfg. Co., Guelph, Ont.

The Valleyfield Electric Company has ordered two 500 light direct current generators from the Canadian General Electric Company.

THE Canadian General Electric Company is installing a 60 kilowatt single phase alternating incandescent plant in the town of Magog, Que.

THE Hamilton and Dundas Street Railway has purchased a four motor G. E. 1,000 equipment from the Canadian General Electric Company.

DUCLOS & PAYAN, St. Hyacinthe, have ordered a 200-light, direct current incandescent plant from the Canadian General Electric Company.

THE Canadian General Electric Company is installing a 200 light direct current incandescent plant, for the North American Bent Chair Company, Owen Sound, Ont.

THE Lake of the Woods Milling Company, at Keewatin, has ordered a 25 kilowatt, steel frame, multipolar, direct current generator, from the Canadian General Electric Company.

THE Brodie mills at Hespeler, Ont., will be lighted with electricity. The Stevens Manufacturing Co., London, has a contract to install an electric plant of 140 arc lights in the factory.

THERE will be keen competition between Canadian and United States companies to supply the plant for the West India Electric Co., which is to build 25 miles of railway near Kingston, Jamaica.

THE Sarnia Gas and Electric Company is installing a 60 kilowatt Canadian General Electric single phase, standard alternator, to meet the demands of its rapidly increasing incandescent lighting business.

I. J. GOULD, of Uxbridge, Ont., is equipping his plant for the supply of incandescent lighting, and has made a contract with the Canadian General Electric Company for a 30 kilowatt, single phase, alternating plant.

LA CIE ELECTRIC DE ROBERVAL, Chicoutimi County, Quebec, has placed an order with the Canadian General Electric Company, for a 60 kilowatt, single phase alternating machine of the company's standard iron-clad armature, compound type.

THE Strathroy Electric Light Co., Limited, is adding an incandescent lighting equipment to its existing arc lighting plant, and has placed its order with the Canadian General Electric Company for a 30 kilowatt standard, single phase alternator of the company's latest type.

WIARTON is to have incandescent light. Young & Crawford have closed a contract with the Canadian General Electric Company for a 35 kilowatt single phase alternator. Work on the installation of the plant is proceeding rapidly and light will be turned on early this month.

THE S. Morgan Smith Co., York, Pa., has recently been awarded the contract to furnish four McCormick turbines, together with iron cases, feeder pipes, valves, draft tubes, etc. These turbines will operate under 15 feet head in the celebrated electric station of the Niagara Falls Power Co., Niagara Falls, N.Y. It is claimed these are the only turbines of American design which will be used in this plant.

THE Canadian General Electric Company has an order from the Lachine Rapids Hydraulic and Land Company, for their citizens' substation, in Montreal, 2-150 kilowatt revolving field type synchronous motors, each of which is to be direct connected to 2-125 light brush arc machines. The motors will be wound to take three-phase current, at 4,000 volts direct from the primary circuit of the Lachine Company.

THE Willson Carbide Works Company of Merritton, Ont., has recently ordered two additional 150 kilowatt, revolving field, single phase alternators from the Canadian General Electric Company. These machines will be installed in the No. 3 power house, and with the four already in operation, of the same type, will be a total capacity of 900 kilowatts to be used the manufacture of carbide of calcium.

THE Light, Heat and Power Company, of Lindsay, Ont., has added to its incandescent plant a 120 kilowatt standard single phase alternator of the Canadian General Electric Company's latest type, with revolving iron-clad armature, and compounded to secure automatic regulation. The Lindsay company has already a 60 kilowatt and 30 kilowatt machine of the same type in operation for several years past, and with the new apparatus will have ample capacity to supply the incandescent lights, numbering between six and seven thousand, connected to the circuits.

THE Hull electric railway earned $31,000 more this year than last.

IT is said that Brockville, Ont., will have its electric railway next summer.

THE street railway in Kingston, Ont., has done a largely increased business this season.

LINDSAY, ONT., has had an electric fire alarm system installed during the past month.

W. H. SUMMERFELDT & SONS, have made a contract with the council to light the village of Sutton.

THE lighting plant at North Bay is to be improved by the installation of a 150 h.p. engine. A new power house will also be built.

IT is proposd to transform the Kootenay Water Supply Co.'s property at Pend D'Oreille, into an electrical plant to supply power to Rossland, B.C.

JUDGE DOHERTY, of Montreal, adjudged Norbert Lepierre the sum of $1,000, his son having been killed while in the employ of the Light and Power Company, Montreal.

A COMPANY has been organized under President Myles, of the H.G. & B., with a capital of $200,000, to extend the line from Beamsville to St. Catharines, a distance of 12 miles.

A PLAN is mooted to build an electric railway between Woodstock and Ingersoll. Stratford and St. Mary's are also spoken of as an equally good, if not better, field for such an undertaking.

THE London, Ont., Street Railway Company's roadbed and rolling stock have been assessed at $230,000, and the company's taxes will probably be increased $5,000 over last year's figures.

THE Lachine Rapids Land and Power Company has made a contract with the Imperial Electric Light Company, which is situated in the east end of Montreal, whereby the former company will be able to supply power as far east as St. Lawrence street.

IN the case of Mrs. Lang vs. the city of Victoria, which was a suit to recover damages for the death of Lang in the street railway bridge accident a year ago, the jury awarded $22,500, less $2,500 insurance, to Mrs. Lang, the widow to receive $7,500, and each child $2,500.

A number of motormen in Toronto are said to be suffering from a temporary blindness, caused by the reflection of the electric lights within the car being cast on the heavy glass of the vestibule. Some of the men are at present under medical treatment. It is proposed to overcome the difficulty by frosting the door windows.

AT a meeting of the directors of the Ancaster and Chedoke Railway, Oct. 14th, Adam Rutherford announced that he had secured all but $4,000 of the $40,000 necessary for the building of the road. He expressed his confidence of getting this by the quarterly meeting in November. A Hamilton man has promised to build the road if the $40,000 is obtained.

A. J. CORRIVEAU, president of the Electric Belt Line Railway, Montreal, is said to be interested in the projected Montreal Southern Counties Railway. The route embraces St. Johns, St. Alexandre, Bedford, East Stanbridge, Dunham, Cowansville, Sweetsburg, Knowlton, Bolton, Eastman, Magog, thence over Hatley Mountain to North Hatley, Sherbrooke via Capelton and Lennoxville.

JUDGE KENNEY and several other New Yorkers visited Drummondville (Niagara Falls South), to inspect the horse-car railway which connects the three villages of Niagara Falls. The Niagara Falls *Review* says a survey has been made to Lundy's Lane and Falls View, the object being to convert it into an electrical road. The only object now in the way is the source of power, but that, it is believed, will soon be settled.

F. S. BARNARD, managing director of the British Columbia Electric Railway Co., Limited, has on behalf of his company just closed a contract with the Esquimalt Water Works Co., which will supply cheap motive power to Victoria, B.C. A power-house with Pelton water-wheels and generators will be erected at Goldstream, at which point the waterworks company will furnish sufficient water under effective working head to develop electric power. The power will be transmitted a distance of twelve miles to the sub-station of the company in Victoria and there stepped down.

THE past year has been a good one for the Montreal Street Railway Company, as the statement of net earnings for the year ended September 30th, which was issued to-day, shows the total net earnings for the twelve months are $507,885.60. Out of this a 4 per cent. dividend was paid in May last, amounting to $160,000, and another in November of 4 per cent., amounting to $166,666.67. With the latter was a bonus of $41,066.66, making a grand total of $368,-333.33. This leaves a surplus of $139,552 27, which, when added to last year's surplus, gives a total of $340,245.51. During the year the company carried 32,000,000 passengers. What the percentage of operating expenses has been is not as yet given out, but it is expected to be about 55 per cent. of the car earnings. Last year the percentage was 56.48, and in 1895 it was 59.20.

Brockville, Ont., is agitating for a municipal lighting plant.

The Canadian General Electric Company is installing a single phase alternating plant for incandescent lighting, for Jacob Morley, of New Hamburg, Ont.

The capital of the Quebec Electric Street Railway Company is to be increased from $320,000 to $400,000, to permit of the completion of the whole line at once.

The W. A. Johnson Electric Co., Toronto, have removed from York street to more commodious and centrally situated offices at 134 King street west, near the corner of York street.

The Sherbrooke, Que., Gas and Water Company has added another 180 K.W. "S.K.C." machine to the plant. It has now two 180 K.W. and two 60 K.W. "S.K.C." machines, from which both light and power are furnished.

The Teeswater, Ont., Electric Light Co., which has taken over the operation of the waterworks and electric light systems at Teeswater, has decided to install an incandescent electric lighting system, and for this purpose has placed an order with the Royal Electric Co., for one of their 500-light "S.K.C." generators with transformers, etc., the work of installation to begin at once.

John Philip, of Grand Valley, Ont., who has heretofore been operating an arc and incandescent electric lighting plant, has decided to go into electric lighting more extensively, and for this purpose has purchased from the Royal Electric Company one of the "S.K.C." two-phase alternating current generators, with 300 light capacity, transformers and supplies. The work of construction is being proceeded with now.

The Chatham Gas Company, Chatham, Ont., which has been operating an arc and incandescent plant in that town for the last ten years, has decided, owing to the corporation installing a plant and doing the street lighting, to go more extensively into incandescent lighting, and for this purpose has purchased a 2,000 light alternating dynamo from the Royal Electric Company, which is to be installed at once.

The bankrupt sale of the effects of C. W. Henderson, manufacturer of electrical supplies, Bleury street, Montreal, took place on the 8th October. The electrical supplies were inventoried at $2,639, and were sold at 44 cents on the dollar; the manufactured goods at $981, and sold at 31 cents on the dollar, and the machinery at $801, went at 76 cents on the dollar. The whole lot was bought in by George Climie, acting for parties at present unknown. It is not likely that Mr. Henderson will resume on his own account.

The Chateauguay & Northern Railway at Montreal is making preparations to handle an extensive freight business in connection with the Canadian Pacific Railway. It has ordered the equipment for an electric locomotive from the Canadian General Electric Company, consisting of a four-motor G.E. 1,000 equipment, with four-motor controllers and commutating switches. This outfit, though of less capacity, is similar to the large locomotive recently supplied by the Canadian General Electric Company, to the Hull Electric Company, which has handled as many as thirty-three cars on a shunt.

In Rutherford v. the H. G. & B Electric Railway Co., a consent judgment was entered after the trial had commenced. The plaintiff, Adam Rutherford, claimed $5,000 damages for alleged wrongful dismissal from the position of secretary-treasurer, and $833 salary in arrears. Mr. Rutherford had been the promoter of the company, and was awarded $2,000 stock in payment of his services, and subsequently engaged as secretary-treasurer at a salary of $800 a year, to date from March 1, 1894. The defence alleged that the grant of stock covered payment for his services until a year later. After a conference between the parties a settlement was arrived at under which Mr. Rutherford received $233 and each side is to pay its own costs.

The Lachine Rapids Hydraulic and Land Company has ordered from the Canadian General Electric Company two direct connected units for furnishing arc lighting from the citizen's station, from which it is at present supplying some 400 arc lamps, generated from steam power, with small arc machines of the "Wood" and "T-H" type. These new units will consist of synchronous motors of the three-phase, revolving field and stationary armature type, each of which will be direct connected to two 125 light "Brush" arc machines. The motors will be wound to take current at 4,000 volts direct from the primary circuit of the Lachine Company, thus saving the cost and loss in operation entailed by the use of step-down transformers. The motors will be self-starting, and are designed to operate at a very low temperature up to the rated load. The efficiency of the arc plant, operated in this way, should be very high, that of the 125-light "Brush" arc machine being not less than 86 to 88 per cent. at full load.

The Perth Waterworks Company, Limited, which is installing the waterworks system for Perth, Ont., will use electric power for pumping. The pump house is located within the limits of the town, but the power which they intend using is about four miles away, on the Tay River. Here they are installing a water-wheel and a 200-h.p. generator which will in addition to supplying the power for pumping purposes, furnish light and power. The company has bought out the old Tay Electric Company, and will distribute light and power on the old circuits. The electrical machinery is being installed by the Royal Electric Company, which will use the "S K C." two-phase system for this work. The pumping is to be done by means of a 75-h p. motor belted directly to a triplex double-acting power pump, which pumps directly into the mains, no gravity system or stand-pipe being employed. The mains are equipped with a relief valve so that the pressure can be maintained constant without varying the speed of the pump. The pump is arranged so as to be operated at two different speeds in order to raise the supply of water and the pressure for fire purposes.

The Cataract Power Co., of Hamilton, having had sufficient stock subscribed to complete their plant, have lost no time in getting down to work. A contract has been let to A. McDonald & Co., of Hamilton, to construct the canal, which will be about 4½ miles long from near Allanburgh to the brow of the "Mountain," not far from DeCew's Falls, where a head of 270 feet will be obtained. The canal will be 30 to 40 feet wide, and 200 to 300 men will be employed in its excavation. The water will be taken from the Welland Canal a short distance above Allanburgh, and the Beaver Dam Creek will be crossed by an aqueduct. The distance from the power-house to the terminus at Hamilton will be 38 miles. This will be the longest electrical transmission line as yet in actual operation, except that of the Blue Lakes Water-Power Co., of California, which transmits power 45 miles. A line is now under construction, however, from the Big Creek Water Co 's plant to San Francisco, by which electrical power will be transmitted a distance of 70 miles, so that the present work will not be phenomenal as to distance. The Cataract Power Co. will have 4,000 horse-power available, and have already closed contracts with a number of corporations and private manufacturing concerns for the supply of power in Hamilton. The principal stockholders in this company are Hamilton men, and it is expected that power will be supplied to the city by the beginning of next May. The contract for the generators, transformers, and all the electrical plant has been let to the Royal Electric Company. A description of this interesting plant will be given in a later issue.

Personal.

Donald Stewart, C.E, died at Halifax, October 19th.

J. C. McNabb, civil engineer, formerly of Chatham, died in Hamilton, Oct. 16th.

Benjamin Leckie, of the G.T.R. shops, Stratford, Ont., has been appointed foreman in the G.T.R. roundhouse at Fort Erie.

The father of Charles Hays, manager of the Grand Trunk, died in New York a short time ago. Mr. Hays has the sympathy of the public in his bereavement.

W. J. Earle, C.E., who was engineer in charge of the harbor improvements at St. John, N.B., has taken charge of engineering work on the Crow's Nest Pass Railway.

In the pulp mills at Milton, Queens county, N.S., a short time ago, Joseph S. Lone, engineer, was caught by a belt and instantly killed. His head was severed from his body.

Carl Weatherbe, son of Mr. Justice Weatherbe, has been appointed professor of civil engineering and mathematics at King's College, Windsor, N.S., vice Professor Butler.

J. Young Henderson, of London, Eng., representing an English pulp manufacturing syndicate, has been in Canada lately, making arrangements for a supply of the higher grades of pulp wood.

Sir Casimir Czowski, C.E., went to England last summer to have a surgical operation performed, but returned to his home in Toronto last month, without the hoped-for relief, and is now very ill.

Walter Chapman, of Barrie, has been made head of the engineering department of the Grand Trunk from Toronto to Nipissing, and all points westward as far as Detroit, with headquarters at Hamilton.

Three new Governors were appointed at a special meeting of the Board of Governors of McGill University held recently, Sir William C. Van Horne, James Ross, and C. S. Campbell, of Abbott, Campbell & Meredith.

W. J. Hamilton, a graduate of the Science faculty of McGill University, Montreal, has been for the past two years superintendent of the Philadelphia Smelting and Refining Works, Pueblo, Col. Mr. Hamilton has been sent to Mexico as superintendent of the works of the same company.

STEAMER "Hero," Deseronto, Ont., will have a new boiler put in during the coming winter.

THE Lake Manitoba Railway and Canal Company will probably establish a steamboat service on Lake Winnipegosis.

A. J. Van Nostrand, of Speight & Van Nostrand, surveyors, has returned from his three months field work in the region of the Wabigoon.

THE D.A.R. Co.'s new steamer "Prince Edward," built for the Yarmouth-Boston service by the Earle Shipbuilding and Engineering Co., of Hull, England, is now in service.

HARRY EATON, late foreman of C.P.R. shop No. 1 (Delorimier ave.), Montreal, has been transferred to Farnham, Que. He left Montreal richer by many tangible expressions of friendship.

IN the Dominion Public Works Department, Paul Wetherby, a graduate of the Royal Military College, son of Judge Wetherby, Halifax, will be the chief architect and engineer, assisted by Mr. Mansel.

CHAS. D. MAZE, civil engineer, has entered an action claiming $5,000 damages from David Oppenheimer, for having made a demand of assignment against him, which demand was successfully contested.

H. C. LANDON has resigned as chief engineer of the Chicago, Peoria and St. Louis Railroad to accept a similar position with the New York and Ottawa Railroad, with headquarters at Cornwall, Ont.

CHAS. GURNEY, son of the late Chas. Gurney, founder of the Gurney Stove Manufactory, died at his residence in Hamilton, a short time ago. Deceased had been ill for a long time. Mr. Gurney was a bright business man when in good health, and was a stockholder in the Gurney-Tilden Iron Foundry.

THE friends of William Sadler, son of J. T. Sadler, and nephew of Ald. G. W. Sadler, of Sadler & Haworth, belting manufacturers, will regret to hear that he died recently at his residence, Montreal, after a continued illness. The deceased was formerly a traveller for Sadler & Haworth, and was much esteemed.

DR. BELL, M.D., B.A.Sc., of the Geological Survey of Canada has been elected a Fellow of the Royal Society of Great Britain one of the highest honors attainable by scientists. The vacancies by death in the restricted membership of the Royal Society are few, and the list of scientific men eligible for election is always large.

THIS winter, there will be sailing from St. John, it is said, a weekly service to Liverpool and to London, a ten-day one to Glasgow, and a fortnightly one to Aberdeen and East coast, Scotland, as well as to Belfast and Dublin, and the C.P.R. reports that the outlook for exports through St. John are better this year than ever before.

JAMES MILNE, superintendent of the Toronto Electric Light Co., has resigned his position in that company to take the presidency of the Weeks-Eldred Co., of Toronto, mechanical and sanitary engineers, and manufacturers of the Jones Under-feed Mechanical Stoker. It has not yet been decided who, if anyone, will be Mr. Milne's successor in the electric light company.

GEO. A. RUSSELL, engineer of the Collins Bay Rafting Company's works at the Toronto Island, has, through the instrumentality of H. P. Dwight, chairman of the investigating governors of the Royal Canadian Humane Association, been awarded a medal by that association for his bravery in rescuing from drowning a young lad named Charles Simpson, 10 years of age, on the 9th of June last.

SAMUEL R ALLAWAY, who has been appointed president of the Lake Shore and Michigan Southern Railway, to succeed the late Daniel W. Caldwell, began his business career with the late Sir Joseph Hickson, then treasurer of the Grand Trunk. He was later with Gilman Cheney in the Canadian Express Company, and went West to take a position on the Great Western with W. K. Muir. He has steadily risen, and now occupies one of the foremost railway positions in America.

ON the occasion of his approaching marriage, the officers of the Richelieu and Ontario Navigation Company met H. Foster Chaffee, district passenger agent of the company, and presented him with a handsome oak cabinet containing a hundred and twenty-five pieces of cutlery, specially imported for the occasion. The presentation was made by C. F. Gildersleeve, the general manager, who explained that the testimonial was a recognition of Mr. Chaffee's merits and the esteem in which he was held by his brother officers.

THE will of the late Mr. Alan Macdougall, C.E., who died in England in April last, has been filed for probate. The estate amounted to $9,400, in addition to some life insurance, and the whole goes to Mrs. Macdougall, to be divided between the two sons, Alan Donald Kenneth and Alan Coursolles Macdougall, and the daughter, Miss Macdougall. In a note Mrs. Macdougall was directed to sell the professional instruments and books, as he did not wish his sons to follow the profession of civil engineer.

WM. T. BONNER, formerly general agent for Canada for the Babcock & Wilcox Company, has recently returned from a trip abroad and will take up his residence in Montreal again, as manager for Canada for the company. Temporary quarters have been taken in the Board of Trade Building, but as soon as the decorators and furnishers can complete their work, the Babcock & Wilcox offices will be located in the Mechanics' Institute Building. A full line of samples and models of the Babcock & Wilcox Company's water tube boilers and accessories will be exhibited. Mr. Bonner has many friends in Canada who will be glad to welcome him back.

Industrial Notes.

LONEY & MCDONALD have erected a new creamery at Williamstown, Ont.

THE Northern Elevator Co., of Winnipeg, is putting up an elevator at McLean station.

M. SHERIDAN is about to build a sawmill at Aylmer, Que., which is to cost $50,000.

THE towns of Berlin and Waterloo, Ont., will, it is said, build an isolation hospital for their joint use.

IT has been announced that the Lake of the Woods Milling Company will erect an elevator at Qu'Appelle.

BROWN BROS, Welland, Ont., contemplate fitting up a steam plant as auxiliary power to run their flouring mill.

A LARGE and modern cheese and butter factory is in course of erection on the G.T.R. line at Bainsville, Ont.

JAS. SAUNDERS, flour miller, Whitewood, Assa., proposes building an elevator at his mill of 25,000 bushels capacity.

FOUR of the shoe manufacturing firms recently burned out in Quebec intend to resume business before January 1.

WM. BAKER, Arnprior, Ont., has recently supplied 30 car loads of brick to the O A. & P.S. Ry. at Depot Harbor, Ont.

THE D. Moore Company, Hamilton, Ont., advanced the wages of the moulders in their foundry five per cent., Oct. 16th.

CHAS. FAWCETT, proprietor of the Sackville, N.B., stove foundry, is completing a large stove warehouse. It is 325 ft. long, 95 wide, and with two flats.

THR Downer Pattern Works, Wellington street west, Toronto, was scorched by fire last month, but Mr. Downer announces that his establishment is again in working order, and he is prepared to fill promptly all orders that come in.

JAMES REID, Quebec. has sold the Pont Rouge Pulp Mill to President McDougall, of the Montreal Quarry Company, who is said to represent a syndicate of Montrealers who intend to spend $40,000 to $50,000 on development.

THE Cowichan Lumber Company, Limited, is to be incorporated to do business at Bobcaygeon, Ont. Capital, $150,000. The incorporators are: M. M. Boyd, W. T. C. Boyd, Bobcaygeon; G. Boyd, H. J. Wickham, Toronto; J. D. Flavelle, J. G. Edwards, Lindsay.

THE Minnesota and Winnipeg Lumber Company, a new organization, will build sawmills in Winnipeg shortly. They have purchased timber limits south of Lake of the Woods, and will construct a canal some fourteen miles to connect with the watercourses leading to Winnipeg.

THE Vessot grain grinder, exhibited at the Toronto Exhibition by the manufacturers, S. Vessot & Co., Joliette, Que., attracted much favorable comment, and a large number of orders have been placed in Ontario for this machine, which was awarded the gold medal at the World's Fair, Chicago.

THE Canada Heating and Ventilating Company, Limited, is applying for a Dominion charter to manufacture stoves, ranges, furnaces, etc., in Toronto. The proposed capital is $25,000; the incorporators are: J. McKelvey, S. Birch, Kingston, Ont.; J. T. Johnston, A. F. Webster, and C. W. Kerr, Toronto, Ont.

ATTENTION is called to the announcement in another column of the sale of the Londonderry Iron Co.'s property at Londonderry, N.S Besides 30,000 acres of mineral land, the company have two blast furnaces, two arc kilns, 67 coke ovens, a rolling mill, a pipe foundry and general foundry, machine shop, etc. Further particulars may be had from Macdougall Bros., Montreal.

THE seventh annual meeting of the Association of Architects of the Province of Quebec was held in Quebec recently, and was presided over by A. T. Taylor. There were present J. F. Peachy, A. Raza, A. C. Hutchison, Jos. Venne, S. H. Capper, A. B. Dussault, A. Mailloux, J. Nelson, J. A. Monette, J. P. Ouellet, J. Z. Resther, G. A. Tanguay, M. Perrault, C. Dufort, H. Stavely, D. Oulette and A. H. Larochelle. After the reading of the minutes of the last two sessions and of the annual report by Jos. Venne, the secretary, the election of officers for the ensuing year took place, with the following results: President, J. F. Peachy; vice-presidents, A. Raza, A. F. Dunlop; treasurer, A. Maxwell: secretary, Jos. Venne; council, A. T. Taylor, C. Baillarge, A. C. Hutchison, J. Nelson, O. Mailloux, L. R. Montbriand.

PIPPY & WRIGHT, Revelstoke, B.C., are starting a sash and door factory.

THOS. STEPHENSON, Cannington, Ont., is extending his carriage works.

THE Locked Wire Fence Co., London, Ont., is exporting to Wellington, New Zealand.

THOROLD, ONT., is trying to induce the rubber factory at Port Dalhousie to remove to that town.

ST. JOHN, N.B., will, it is said, float a loan of $125,000, to be applied to the harbor improvements.

THE waterworks plant at Waterloo, Que., has been offered to the municipality by the owners for $21,000.

A BOX factory is to be established at Orillia, Ont., and the corporation will exempt it from taxation for a period of ten years.

MAYOR BREITHAUPT, of Berlin, Ont., is reported to have said that he would not be satisfied till the town bought a steam road roller.

IT is said that the Rathbun Co. will remove its saw mill from Lindsay to Fenelon Falls, Ont., thus saving a considerable sum in towage.

CORNWALL, ONT., which recently returned to Brockville, Ont., the road roller hired from that town, will probably buy one for its own use at an early date.

ONE of the conditions upon which the contract of building the sewers in Nelson was let to E. Bragg, was that he should pay $2.50 per day to his laborers.

THE village of Ashburnham, Ont., is placing a water system chiefly for fire protection, the supply to be taken from the Peterboro waterworks by meter.

THE town council of Welland, Ont., has decided to buy from Goldie & McCulloch, Galt, Ont., two boilers of 40 h.p. each and one 80 h.p. engine for $1,275.

W. H. LEVER, the manufacturer of "Sunlight" soap, will, it is said, establish a large factory in Canada, at Toronto, and another somewhere in the United States.

THE Hon. A. S. White, W. J. Mills and E. A. Charters are a committee to prepare a report on the cost of a sewage system and water supply for Sussex, N.B.

COTE ST. PAUL, near Montreal, is to have both a drainage and light system. It is the intention to complete the drainage first, and work will be proceeded with at once.

THE New Denver, B.C., electric light plant is likely to be so extended as to supply power for pumping the proposed water supply. The town is asked for a bonus of $2,000.

ABRAHAM GOODWIN and John Kerr, Brantford, have bought out the repair department of the A. R. Williams Co.'s machinery agency there, and will operate it on their own account.

LOCAL newspapers in Newfoundland are pleased at the increased prospects of the development of the pulp industry in that colony. Scottish dealers are now said to be entering the market freely.

JNO. MCDOUGALL, Montreal, has the contract for putting in two filters, each of 216,600 gallons capacity per 24 hours, in connection with the Renfrew waterworks plant now being installed. Price, $3,000.

BUDD BROS., Renfrew, Ont., are lighting their premises with acetylene. They have built the isolated stone or brick receptacle outside the building, required by the new regulations of the fire underwriters.

THE Canadian Typograph Co., Windsor, Ont., elected the following officers at the annual meeting: Joseph Taylor, president; F. S. Evans, secretary-treasurer: Cameron Curry and George H. Scripps, directors.

THE Milner-Walker Wagon Company is converting the old sugar refinery in Walkerville, Ont., into a wagon factory. When the change is complete the works in Chatham will be closed and the whole business moved to Walkerville.

THE Hamilton and Toronto Sewer Pipe Co., Hamilton, Ont., has had its assessment fixed by the city council at $8,000 for five years. This amounts to a considerable exemption on the fine new premises the company is building.

THE Sherbrooke Street Railway Co. is using one of the Geo. E. Smith power rail bending machines in the construction of the line. This is a great labor saving machine; being very powerful, it does the work of ten men and has a capacity of one rail per minute.

PORT COLBORNE, Ont., recently sent a committee to Caledonia, N.Y. (a town of 1,200 inhabitants), to report on the waterworks plant there. It was found that the pumping engines were run by natural gas engines, electrically ignited, and the cost of fuel during August was $3.57.

A FARMER'S elevator company is being established at Lumsden, Assa. It is proposed to build a 30,000 bushel elevator.

THE Chicago firm which is manufacturing the three-wheeled "bicycle" is looking for a site for its Canadian factory.

DEYELL & Co., of Souris, have two new elevators under construction, one at Killarney, and the other at Pipestone, Man

WM. POSTLETHWAITE is making arrangements to build an elevator at Souris, Man., for the syndicate of grain dealers of which he is a member.

THE people of Renfrew have subscribed over $700 to assist W N. Roberts in rebuilding his wood working factory, burned a short time ago.

PUGSLEY, DINGMAN & Co., Toronto soap manufacturers, are moving to Toronto Junction, exemption from taxes for ten years having been granted.

THE new elevator for the Montreal Transportation Co at Kingston, Ont., will have two legs and a discharging capacity of 24,000 bushels per hour.

NELSON, BUZZELL & Co., Cowansville, Que., report a very busy season in creamery and cheese factory apparatus, of whose manufacture they make a specialty.

THE S. Morgan Smith Co. has recently shipped to H. Mc. Hart for his pulp mill near Halifax, N.S., a 36 inch horizontal McCormick turbine on horizontal shaft, which will develop 350 h p.

H. W. PETRIE, of Toronto, has sold to George Easterbrook for shipment to Delagoa Bay, South Africa, an engine, with other machinery and supplies, for his flour mills to be erected there.

AT the farm of Mr. Hardiman, three miles from Sault Ste. Marie, a young man, David McGill, was killed and four others seriously injured, by the boiler of a steam thrasher exploding on October 16th

THE work on the new water supply system in St. Hyacinthe, Que., is being pushed to a successful conclusion. The original grant of $35,000 has been found inadequate, and has been increased to $50,000.

THE estate of Alex. Rankine, proprietor of the nut and bolt works, St. John, N.B., who made an assignment early in the year, has been wound up. The creditors were recently paid a dividend of twelve cents on the dollar.

THE city engineer of Toronto has been instructed to report on the purification and disposal of sewage from the Garrison Creek, Rosedale and Don sewers. This is the first step toward the removal of sewage pollution from the bay.

THE tannery owned by A. G. McCrady & Son, Brockville, Ont., which has not been worked for some time, has been started up again, a lot of new machinery supplied by the Lancaster Machine Works of Lancaster, Ont., having been installed therein.

THE cement in use in the new Queen street subway, Toronto, is being supplied by the Owen Sound Portland Cement Co., Limited, Shallow Lake, Ont. This company is preparing to enlarge its output considerably, and is now building four new kilns.

THE description of separate sewage systems for the disposal of surface water and domestic sewage in another part of this paper, is of interest in connection with the report of Willis Chipman on this subject, recently made to the city council of London, Ont.

CHAS. CASSILS has been appointed agent in Montreal for the Carnegie Steel Company, Pittsburg, Pa., producers of rails, angle bars, and other heavy iron work. The trade between the United States and Canada in this class of merchandise is rapidly growing.

THE Wm. Emerson Manufacturing Co., Lawrence, Mass., has concluded arrangements at Granby, Que. The W. Hibbard water power has been secured, and a building 50 by 100 feet, two stories high, is to be erected. The municipality granted exemption from taxation.

EXTENSIVE alterations have been made in and about the G.T.R. depot at Cornwall, Ont. The end of the freight shed has been pierced and a track laid through the same, connecting with the electric street railway, to enable that company to handle the freights for the town and mills.

WM. Harris, Toronto, cattle dealer, has built an abattoir for export business in chilled meats, just to the south of the Toronto cattle market. The building is now nearly ready for occupation, and will, it is understood, be supplied with cold storage apparatus by the Linde British Refrigerator Company.

THE DeLoach Mill Mfg. Co., of Atlanta, Ga., manufacturers of sawmill machinery, hay presses, cane and grinding mills, and the James Ohlew & Sons Saw Mfg. Co., of Columbus, Ohio, have placed the Canadian agency for their products in the hands of the Lancaster Machine Works, Lancaster, Ont.

Some lumbermen are figuring on building a canal from Buffalo Bay, on the Lake of the Woods, to Seine River. There is a fall of three hundred feet and over between these points, and the scheme embraces the floating of logs to Winnipeg to be sawn into lumber from the Lake of the Woods timber limits, the supplying of water from the lower end of the lake to the city, and a water power system.

The gas engine works of J. R. Baird, Woodstock, Ont., are now running overtime. One of Mr. Baird's gasoline engines has been purchased for use at the Royal Military College, Kingston, and one has been bought by the proprietor of the Mitchell *Advocate* to run the presses of that paper, Another Baird engine has been shipped to a Toronto man to operate an isolated electric lighting plant.

George H. Bertram, president of the Bertram Engine works Company, Limited, Toronto, the great steamship and engine builders, and also of the hardware firm of Bertram & Co., has been compelled, owing to the increase of the shipbuilding company's business, to withdraw from the management of the hardware firm. His successor is his son, John H. Bertram, and the style of the firm becomes Bertram, Wilson & Co.

The S. Morgan Smith Co., of York, Pa., has recently shipped to the Acadia Pulp Co., Milton, N.S., a pair of 36-inch McCormick turbines, mounted on horizontal shaft, which, when placed in position, will develop 1,500 h.p. The single 33-inch McCormick turbine, mounted on horizontal shaft, shipped a couple of weeks ago to this same company for the pulp mill in New Germany, is now in operation and has 300 h.p. capacity.

The Tombyll Upholstering and Frame Manufacturing Company Limited, is asking for incorporation, the chief place of business is in the town of St. Henri, Que. The proposed amount of capital is $75,000. The incorporators are: Rasmus Nielson Tombyll, manufacturer, St. Henri; Wm. Henry Turner, Montreal; George H. Labbe, Montreal, manufacturer; Thos. Tombyll, St. Henri, upholsterer; Amedee Anaclet Bernard, of St. Henri, physician.

The evidence in the Sherbrooke Water Works arbitration case has all been submitted, and the commissioners, Wm. Kennedy, C.E., Montreal; B. D. McConnell, Westmount, Que., and E. H. Keating, C.E, Toronto, have made their report. The witnesses on the side of the city were Willis Chipman, C.E., Toronto; Charles Baillairge, C.E, Quebec, and J. A. U. Beaudry, C.E., Montreal; and those for the company were A. Sangster, C.E., superintendent of the works; E. F. Waterhouse, sec.-treas.; S. W. Jenckes, of the Jenckes Machine Co.; R. N. Arkley, millwright, and others. The property included the water power and pumping station land, the reservoir lots, the plant and piping, and the unexpired portion of the contract. The award is for $115,967, of which $21,897.69 is the value of the unexpired contract. Cost of the arbitration, including witness fees, was $2,000

The main power for the Perth, Ont., waterworks is to be brought from a dam four miles up the Tay. John McDougall, Montreal, has been engaged to build the dam and the flume, and to put in the waterwheel and build the power-house. The Royal Electric Company, of Montreal, will put in the electrical plant. From this plant the waterworks company will rent power in town where wanted. The company has arranged to use an island for the reservoir, etc. They will run an open drain from the upper end, 15 feet wide at the top, 10 at the bottom, with a depth of water of 4 feet. At the end there will be a filter-bed. The water thus purified will run into a collecting basin at the end of the filter and enter a fifteen-inch pipe, where it will find its way 1,200 feet under and beside the river channel till it reaches the suction well. The pumping-house, which will be built behind this, will be of brick on stone foundation, 30 x 30 feet. A fifteen-inch main will supply the water from this to the town.

The Recorder of Montreal rendered judgment recently in the case of the City vs. Eusebe Paquette, contractor, for using hollow tile instead of ordinary bricks in the construction of the inner walls of a building. The action was dismissed with costs against the city, the court holding that in the case at issue the wall complained of had been shown to be perfectly safe for the weight it had to bear, while the evidence went to establish that, in case of fire, the tile walls were superior to others, on account of their ability to withstand more heat. The by-law under which the action was taken was one to prevent accidents through defective construction and through fire; the hollow tiles, which were invented only after the passing of this by-law, were proved to be of incombustible material, and to answer both purposes fully. As for the pressure that they could stand, the tests made at McGill College were conclusive, and the court had no hesitation in saying that in the present case, at least, the requirements of the law had been fully met.

A very large number of the employees of the Central Bridge and Engineering Co., Limited, waited upon W. H. Law, the late managing director, at his residence, a short time ago, and presented him with the following address: "*To Wm. H. Law, Esq., C.E.:*— The employees of the Central Bridge and Engineering Company, Limited, upon the severance of your connection with the works desire to avail themselves of this opportunity of expressing to you their keen appreciation of the kindness received from you in the past. Those of us who have been connected with your works since their inception in the town of Peterboro', over fifteen years ago, fully realize the amount of ability and perseverance required to place these works in a position to successfully compete with the long established bridge firms of Canada, and in their own particular line to occupy a place second to none, as shown by the important works recently completed by the company. We join in wishing you and Mrs. Law all possible success and prosperity in the future, and beg that you will accept these slight memorials of our esteem and regard. Signed on behalf of the employees, Geo. Baker, J. Daynard, John Glenn, R. Robson, C. Dawson, A. Craig, Wm. Foster, jr., F. Hamilton, C. Stevens, Thos. Jevons, W. J. Francis. Peterboro', Ont., Aug. 25th, 1897." The mementoes mentioned consisted of a gold watch chain and locket, with monogram, combining the letters, W. H. L., and on the obverse a suitable inscription. The gift to Mrs. Law is a gold ring set with a solitaire diamond. Mr. Law is at present engaged in connection with several patents he holds for England, Canada and the United States.

A correspondent of an English industrial paper states the case of the employers as against the strikers in the present war in the engineering trade in Great Britain, thus: "The real issue in the present severe struggle in the engineering works of this country has been obscured by irrelevant matter. The cause of the struggle is that the trade unions have interfered in the management of the works by their owners, and have ordered the owners to make serious changes in their management under threat of compelling the workmen to strike. The trade unions have ordered the owners to employ full-priced mechanics to work certain machine-tools that can be worked by junior hands or laborers, and are so worked in other countries. The trade unions have ordered the owners to work each machine-tool by a separate man, instead of one man working two or three machine-tools simultaneously, as is done in other countries. They have ordered that a uniform rate of wages be paid in each trade, for good, bad, or indifferent hands. They have ordered certain men to be discharged from the works because not members of the trade union. They have ordered certain foremen to be discharged, because not under the control of the trade union. They have ordered the speed of turning out work from certain machines to be limited below their full capacity, for the purpose of increasing the number of workmen necessary. They have ordered that one mechanic shall not do any work of another trade, although competent to do it and required to do so for the convenience and expedition of completing the special work in hand. And now the trade unions are wanting to order the owners to pay the workmen nine hours' wages for eight hours' work, and to let their machinery stand idle for the remaining hour of each day."

KLONDIKE A mechanical engineer of steady habits and general experience, going to the Klondike in the spring, to take up and work a claim, is desirous of meeting "a mate." References exchanged. Address "BOB," care of Canadian Engineer, Montreal.

SITUATION WANTED—Young man, practical machinist, at present engaged in the editorial office of a mechanical newspaper in New York, desires similar position with Canadian publication devoted to the same interests. Stenographer (speed, 150 words per minute) and typewriter. Age 24 years. Address M. C., care Canadian Engineer.

The Londonderry Iron Company, Limited

THE DIRECTORS of the above company having authorized us to negotiate for the disposal of its extensive properties and works at or near Londonderry, N.S., we are prepared to submit a schedule and to treat with reliable parties. The properties consist of about 30,000 acres of selected mineral lands held in fee simple, free of royalties, besides a further extent of mining rights, two blast furnaces completely equipped, two ore calcining kilns, sixty-seven coke ovens, a large rolling mill, a pipe foundry, a general foundry, a well equipped machine shop, about twelve miles of railway, with four locomotives, cars, etc., etc., numerous houses and all the plants incidental to the production of iron on a large scale.

MACDOUGALL BROS., Montreal

The Canadian Engineer

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. V.

ROADBED CONSTRUCTION.

ART. 15.—WATERWAYS.

The construction engineer, after retracing the centre line, and checking levels, and establishing additional B. M.'s, if necessary, should verify and complete the list of structures fixed upon by the survey party.

The class of structure will depend upon the money and material available, but its cross-section, if it is a waterway, will depend on the *maximum* flow of water it is expected to carry, while if it is a cattle pass or public crossing, its *minimum* dimensions will be fixed by law. Many causes affect the maximum flow of water across a railway roadbed, at a given point, besides the drainage area; in the case of small streams or local watersheds, the building of the roadbed, and consequent roadbed and catch-water ditching, will concentrate the flow, from quite a large area, on a culvert that would naturally have had much less flow to accommodate; this should be anticipated. Then, again, the construction of a railway in a new country will induce such activity as will cause large tracts of forests to be cleared off, and in a few years these cultivated areas will allow storm waters to pass off more rapidly than when the same area was in forest; which should therefore be anticipated and provided for. If the drainage area is in a nearly level country, water will arrive at a given point more gradually than if the slope of the country is abrupt; and also the shape of the drainage area and distribution of tributaries has a marked effect on the maximum flow. If a long stream has few and small branches, the maximum flow will be much less than where there are more and larger tributaries and less main streams, the total area being the same, especially if they empty just above the railway. In this case the flood water from all of them may arrive about the same time. Stony ground, also, sheds water much more rapidly than mellow and highly cultivated ground, and small areas are more liable to *abnormal* floods than large ones, because cloud bursts seldom occupy large tracts of country.

All such considerations should be weighed along with that of acreage, which should be determined, roughly, by personal examination, for every area large or small draining toward and across the railway under construction. There are several empyrical formulæ, purporting to connect the square feet of waterway required with the acreage drained, but they, necessarily, contain a co-efficient which varies with so many causes, such as those just given, as to make them difficult of application, even leaving out of question, the variation in rainfall in different localities. Indeed, it is the greatest rainfall for short periods that is the most important factor, and records of this are usually deficient.

The carrying capacity of a box or arch culvert may be made a maximum by digging straight wide approaches and offtake ditches, and by building flaring wings at each end to avoid contraction, and may be abnormally increased by designing it to carry a head of four or five feet of water in an emergency, which of course, increases the velocity—this, however, is hardly safe practice.

Baker's "Masonry Construction" has these formulæ:

(1) *Myer's.*—Area of waterway in square feet = $C \sqrt[2]{\text{drainage area in acres}}$. In which $C = 1$ for rolling prairie, $1\frac{1}{2}$ for hilly ground, 4 for rocky precipitous ground. This formula, Baker considers, will give too large results for small areas, and too small results for large ones.

(2) *Talbot's.*—Area of waterway in square feet = $C \sqrt[4]{(\text{Drainage area in acres})^3}$. In which, $C = \frac{2}{3}$ to 1 for rocky precipitous ground, $\frac{1}{3}$ for rolling ground, landing floods and snow at same time, and $\frac{1}{8}$ to $\frac{1}{6}$ for long narrow valleys with little or no snow. This formula, used with judgment, will probably give as good results as can be expected, where there are so many varying conditions.

Aside from any data as to acreage, etc., the high water mark at some narrow point in the channel may be noted, information from old residents as to abnormal freshets gathered, the waterway under any existing highway bridges measured, and any other influences noted bearing on the maximum flow, such as the rain records for

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

past years for the nearest weather station, and the probability of the maximum flow being increased by clearing the country, if at present in forest, etc.

It is best to err on the large side, although some engineer has said that if a road has no wash-outs from too small waterways now and then, the structures are too large for ultimate economy.

ART. 16.—STRUCTURES FOR SHALLOW EMBANKMENTS.

The first consideration is to get water across the roadbed and away from it as quickly as possible, this is an axiom of good drainage. To do this where the embankment is from 6 inches to 2 feet deep, and the drainage area only nominal, is often a puzzle. We do not wish to leave an opening in the track, and pipes or stonework are impossible; the usual course is to fill in the pocket above the bank and drain through the track by track boxes (Plate 1, Fig. 20), or where there is from 18 inches to 3 feet of a bank in place of an open culvert which some engineers put in, a plank box (Plate 1, Fig. 21) is preferable, as it can be replaced easily when rotten, will stand the vibration of trains, and does not leave any opening in the track. Sometimes with a very slight drainage area, a blind or French drain is used, which consists of small flat stones placed so as to give a triangular opening of, say 6 inches high x 8 inches wide, but such a waterway is liable to get choked up with leaves, etc., and cannot be depended on indefinitely.

When we come to banks of from 3 feet to 6 feet in depth it is usual to employ iron, terra-cotta or concrete pipes if the waterway is small, and when a heavy flow of water necessitates it, open culverts of from 4 feet to 8 feet span. These latter may be of timber, stone, concrete or brick, but should always be surmounted by an ordinary trestle floor. The use of stringers only is an abomination and a death trap, which should not be tolerated.

Culvert Pipes.—The use of double-strength, well-burnt sewer pipe for culverts has increased rapidly of late years in certain sections. They fill a certain want, either where stone is scarce or absent, and at points distant from water or rail communication, as the cost of teaming is small compared with that of iron pipes. In a country subject to severe frost certain precautions must be taken to avoid water settling under or in the pipes, which will crack them in freezing. The grade must be ample, care taken to have the grade convex longitudinally of the pipe, rather than concave, the joints made watertight with cement mortar, and headwalls built at each end with deep aprons, to avoid having any water flow along the pipe outside of it. In southern localities of the United States, America, pipes are used more freely and carelessly, head walls and joint filling are omitted, or only a timber headwall used, but such omissions will invite trouble in Canada.

Again, if the bank is shallow, the same care is hardly necessary in ramming back the filling around the sides of the pipe before loose dumping is commenced as if it is a deep one, but in either case care should always be taken to cut a concave bed for the pipe to rest in and grooves for the spigot joints, or otherwise the load will all come on isolated spots, and the pipe will tend to crack into four segments, bulging out at the sides and down at the crown. If the bottom is solid rock or bouldery, the condition is worse, and breakage can only be avoided by filling in some soft clay well rammed to bed the pipes in, or, better still, to bed the pipe half-way in cheap concrete, as shown on Plate I., Fig. 22. This figure also shows design for a headwall and paving at the lower end. The spigot ends of the sections are always laid up grade. As with other more important structures, pipes should be laid at such a depth that the outlet ditch leads the water to a safe distance with a gentle grade, so as to prevent undermining the lower end.

In place of sewer pipes of clay, there have been isolated attempts at using concrete pipes, but only sporadically. The choice would be entirely a matter of cost. On the other hand, the use of cast-iron culvert pipes is quite common. They can be made up to six or eight feet in diameter, the lengths decreasing as the diameter increases, so as to keep down the weight of a segment. If carefully coated with tar mixture rusting is very slow; and although such pipes are not used often during construction, owing to their great weight, which is against them in hauling by teams, they have a special function which is for use, when their transportation can be by train, in replacing wooden box culverts by drawing through

Plate. I. Scale 1 in. = 8 ft

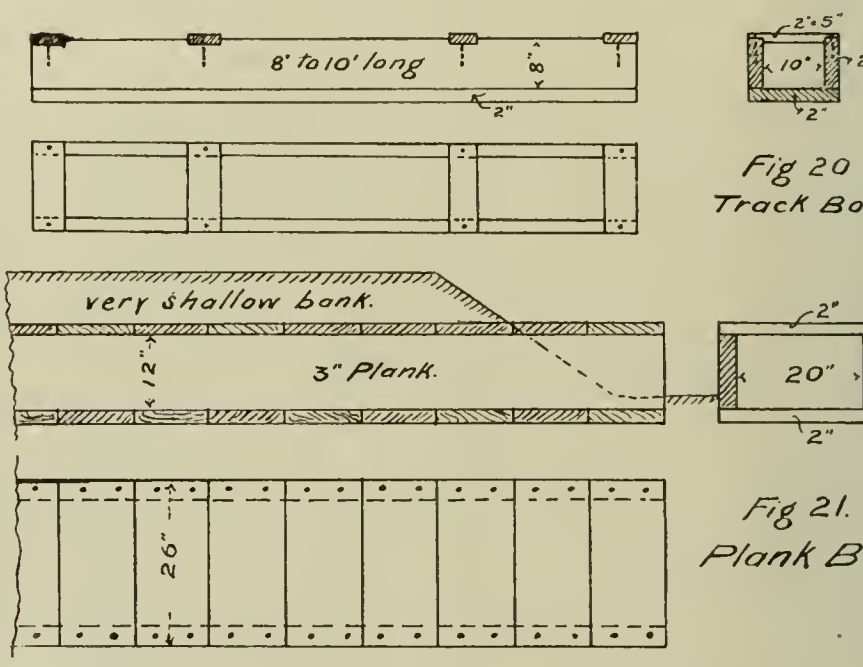


Fig 20
Track Box.

Fig 21.
Plank Box.

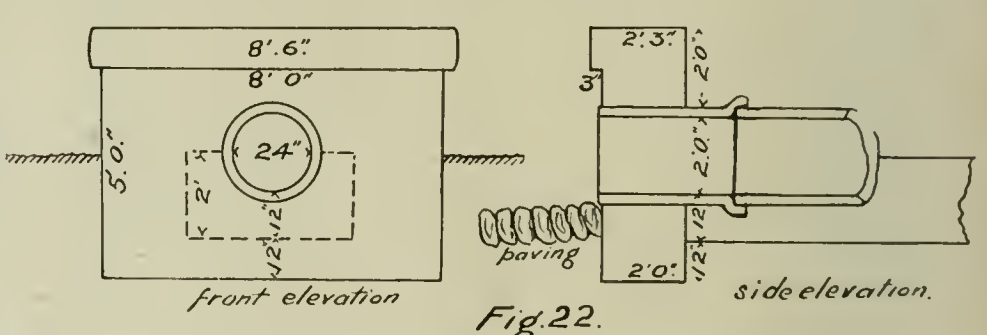
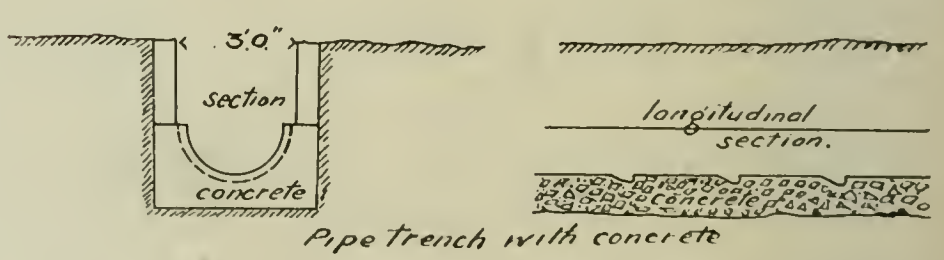


Fig.22.
Headwall for Iron or Terra-Cotta pipes.



Pipe trench with concrete

when the wooden one is about decayed, and in case this has been anticipated the wooden box culverts will have been made larger than necessary, sufficient to allow of this being done. Cast iron pipes will be laid in the same manner as sewer pipes, except that the joints should in this case be caulked and leaded as with water pipes, although sometimes this is omitted; the cost per foot for cast iron and sewer pipes at the nearest railway depot to the structure will vary somewhat with the locality, but will be approximately as follows:

TABLE XII.

APPROXIMATE COST OF PIPES (NOT INCLUDING LAYING.)

Diameter.	Sewer Pipe. Cost per foot.	Cast-iron Pipe. Cost per foot.	
12-inch	35cts.	$1 15	This does not include cost of hauling, laying, headwalls or foundations.
18-inch	70 "	1 90	
2 feet	$1 30	3 00	
3 feet		4 80	
4 feet		8 00	

The difference of cost, as shown in the table, the less cost of handling and laying of the sewer pipe and its absolute freedom from corrosion will always be greatly in favor of its adoption where well-burnt, salt-glazed, double-strength sewer pipes can be obtained within reasonable length of railroad and team-haul.

Open Culverts.—Where a large flow of water is to be carried across a shallow bank some engineers use two or three lines of pipes, but the danger of this method lies in the possibility of debris collecting around the middle walls and gradually choking up the waterway. This can be guarded against by building a screen or paling some distance above the entrance, which catches the debris. Generally speaking, however, a large stream and shallow bank demands an open culvert. In many cases these may answer the double purpose of waterway and cattle guard, or waterway and cattle-pass, for giving passage for cattle under the track. Such structures may be of timber, stone, concrete or brick walls, capped with stone; but whatever kind may be used, they should be decked with a complete trestle floor, such as to make them safe for derailed trains to pass over. And indeed, latterly, some roads are adopting a solid timber floor, on which the ordinary road ballast is laid, or better still, a floor of discarded steel rails, laid longitudinally, filled in with concrete and covered with ballast; in either case the roadbed is continuous, and free from danger by derailment or fire, and presents a more elastic and uniform bearing for the track ties.

On Plate II. (Figs. 23 and 24) are shown plans for a 6-foot open culvert of timber or stone. If the bank were deeper, the stone walls would need to be thicker, being designed as level retaining walls, and the timber culvert would need a more thorough system of interior struts, etc., for stability. If the embankment cross-section were to show a rapid descent just at the mouth of the culvert, it would be more economical to place the stepped wings at right angles to the walls, in the form of head walls, about six feet from the centre line. This is not done, ordinarily because less economical, less stable, and subject to vibration and thrust from the train.

The timber open culverts should be well drift-bolted in each course, and have the stringers also notched down slightly and drift-bolted to the walls—the mud sills well sunk into the solid earth, and preferably with paving between them and a sheet piling apron at each end to prevent under-flow and undermining, as shown on Plate IV. (Fig. 28.) If the foundations are not good, a structure, on piles, similar to the one shown on Plate III. (Fig. 25), will need to be used. The earth being retained by a layer of four inches to six inches cedar flatted on three sides, and the two walls held vertical by drift-bolting and notching down the stringers, or if necessary, by additional struts placed from top to top of piles as shown in the figure. The use of high-framed timber openings on mud-sills, lagged behind with cedar like that in Fig. 25 is not advised, they are not stable and are liable to be undermined. Wherever a depth sufficient for cattle passes or farmers' undercrossings is required, it is better to put the structure on well driven piles extending up to grade, if a stone opening cannot be afforded.

The valid objections to open culverts with vertical walls are:

(*a*) That the structure being fixed in elevation, offers a rigid support to the track which, on banks, and on freshly made ones particularly is elastic and settles down for several years, and rises and falls with the frost; therefore, at such structures there is more or less of a hump, and always a poor piece of track.

(*b*) That in case of the timber culverts, the lagging behind the piles rots quickly, and is rather awkward to replace.

These considerations have led to the use, especially in the southern United States, of a form of structure shown on Plate III. (Fig. 26), which consists of two bents of piles, or two frame bents on pile foundations, with three 15 foot spans of trestle floor, having the two end supports made of mudsills resting well on to the banks. It is probable that 45 feet of trestle floor is not appreciably more dangerous than 15 feet of it, and the only valid objection to this form of structure is that the frost will heave the ends out of surface in climates like that of Canada or the northern United States, but its openness for repairs, the elasticity

Plate II. scale 1 in. = 8 ft.

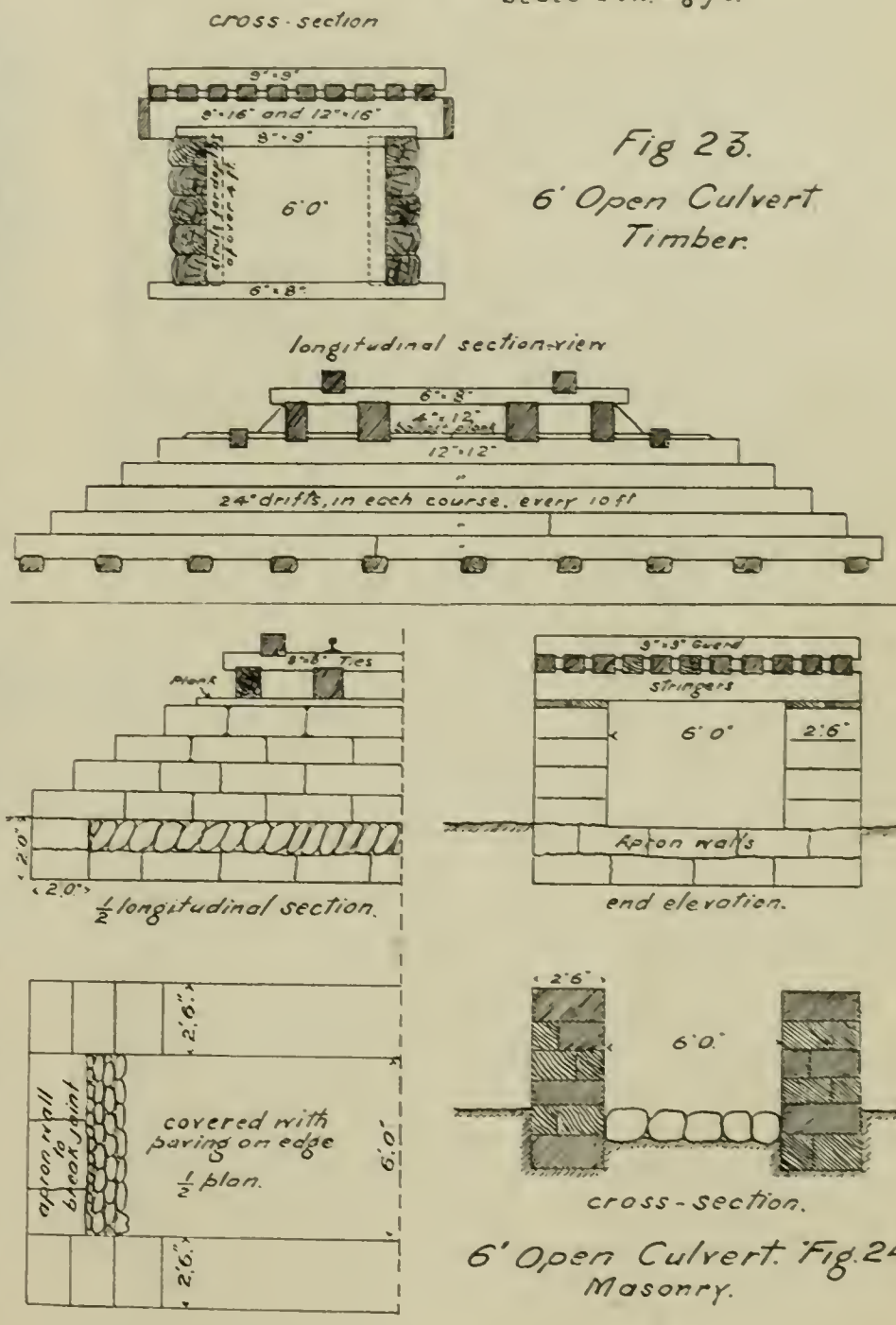


Fig 23. 6' Open Culvert Timber.

6' Open Culvert. Fig. 24. Masonry.

of the ends which rise and fall with the embankments, its freedom from rot, except the easily replaced mudsills, and the possibility of an enlarged waterway by rip-rapping the sloping banks, to allow for an exceptional flood, are all points much in favor of such a structure. This structure is evidently limited to banks less than eight feet high.

The class of masonry for open culvert walls will need to be superior, owing to the effects of vibration from the trains, to avoid part of which oak planks should be placed under the ends of the stringers. The class usually specified is second-class bridge masonry, and will cost from $8 to $10 per cubic yard upward, depending on the quantities in each structure and total quantity in the contract. The economy of rubble concrete walls capped with a stone coping is being now recognised.

The cost of structures of these styles will be approximately as given in Table XIII., taking masonry at $10 per cubic yard, including foundations; paving at $3 per cubic yard; sawn timber at $30 per M.B.M., in place including iron; cedar lagging and timber walls at $25 per M.B.M. in place, and piling at 30 cents per lineal foot, driven, say, 10 feet into the ground.

TABLE XIII.

APPROXIMATE COST OF OPEN CULVERTS.

Structure.	Height of Waterway.	Clear span in feet being 6 feet.	8 feet.	10 feet.	12 feet.	15 feet.
		$	$	$	$	$
Timber opening.	4 feet.	106	116	126	135	148
Timber walls.	6 "	157	167	177	186	201
(Fig. 23.)	8 "	212	222	233	243	259
Timber opening,	4 feet.	110	118	125	133	145
piles and lagging.	6 "	144	152	158	167	179
(Fig. 25.)	8 "	168	176	183	191	203
Three span.	4 feet.			170	203	251
Opening on piles.	6 "				208	256
(Fig. 26.)	8 "					267
Stone opening.	4 feet.	317	341	365	389	426
Trestle floor.	6 "	457	481	505	529	566
(Fig. 24.)	8 "	608	632	656	680	717

From which it is evident that piles with lagging are slightly the cheapest, except with the smallest height and span, and that at 8 feet high and 15 feet span the three-span opening comes to about the same as the other timber structures. The cost of the stone opening is from two to three times as great as the timber ones in first cost, at $10 per cubic yard, but in many cases this could be materially reduced by using concrete at $6 to $8 per cubic yard, at which price a very superior quality can be made even in small quantities. An interesting feature of this table is the deduction that the length of span affects the cost so slightly, it will hardly pay to risk anything in size of waterway for such trifling economies.

ARTICLE 17.—SMALL WATERWAYS WITH HEAVY EMBANKMENTS.

Under these conditions pipes may still be used, if care is taken in laying them; up to any height, if the waterway is very small; but for cross-section areas of four square feet to twenty square feet, the structure commonly used is the box culvert, which may be made of timber, stone, concrete or brick. The two latter, however, being used, usually, in the arch form, as otherwise stone covers are necessary.

Timber Box Culverts.—These are used where cheap structures are desired, or often in undeveloped districts where construction is hurried, timber plentiful, and stone scarce, they should not be put under embankments more than 12 feet to 15 feet high, unless built large enough to admit iron pipes that will carry the rainfall after the timber culvert has begun to decay, which will be in six to twelve years, depending on the timber, etc. If the bank is a shallow one, it will not be very expensive to replace the decayed timber culvert by another similar one, or by a stone box culvert, at a time when stone can be cheaply delivered by rail and the company can afford the outlay, and if the covers are made long, as in Plate IV. (Fig. 27), they will hold up for a year or so after the side timbers have started to rot. Of the two styles shown, the one (Fig. 28) is superior in some respects. It is fastened by iron drift bolts, instead of oak tree nails. It has a row of sheet piling driven at the ends to prevent underflow and undermining, and has solid paving laid between the mud-sills, all of which are distinct improvements. For such structures, probably, cedar is the most durable wood, and pine next A distinct advantage of timber box culverts is that on soft swampy foundations, all that is necessary is to make a wide solid floor of timber instead of mud-sills, and even lay this floor on several sills running lengthwise of the culvert to distribute the loads over the whole area. Even though some settlement should occur, the elasticity of the timber will save the structure from damage, whereas with a stone or brick culvert any serious settlement means destruction to the masonry.

Stone Box Culverts.—Typical plans are given (Figs. 29, 30, 31, 32) on Plates IV. V. and VI. to illustrate essential differences in stone box culverts.

(*a*) Fig. 30, Plate V., shows a solid stone floor under walls and for paving, while the others have the walls independent, which is much preferable because the loads are carried symmetrically to the foundation, *i.e.*, the centres of pressure are opposite the centres of resistance, because the paving may become dislodged without the walls being injured and because the walls may, if desired, be carried lower than the paving, as in Fig. 29.

Plate III

scale 1 in. = 8 ft.

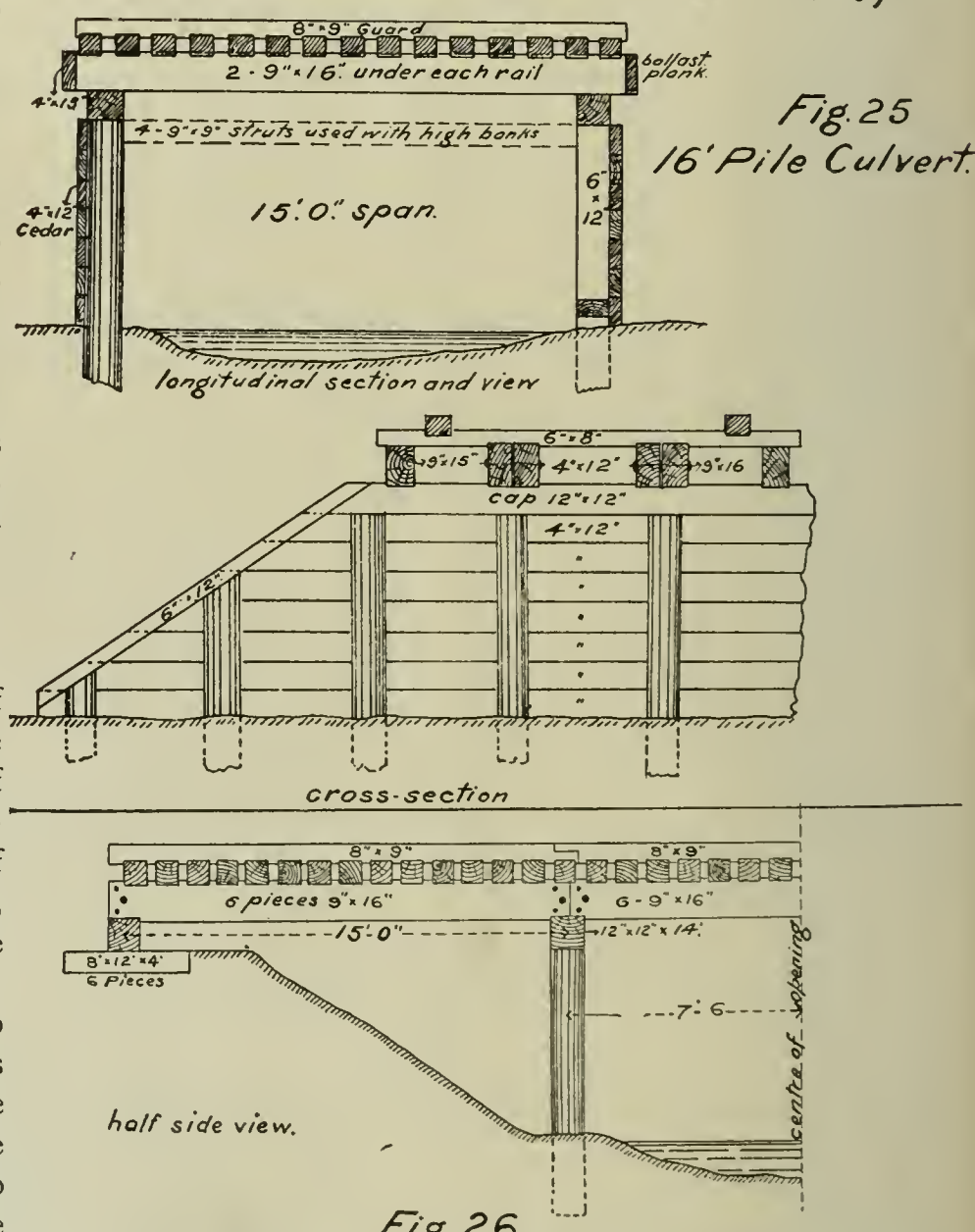


Fig. 25
16' Pile Culvert.

Fig. 26.
Three-span Opening.
(in place of one 15' span pile culvert.)

(*b*) Figs. 30 and 32 show head-walls while the others have straight-stepped wings, the latter is better practice because no amount of sliding or thrusting of any kind from above, can dislodge more than the parapet wall, which is only an ornament, whereas head-walls as in Figs. 30 and 32 can be easily cracked or thrown down by slides in the embankment.

(*c*) Fig. 31 illustrates the use of corbelling where a wide span is required and stone for long, heavy covers is scarce, this method may be developed into a complete gothic.

(*d*) Fig. 29 has a distinctive feature in the *well* formed by the projecting upper wings, which will effectually prevent blocking the mouth with debris, because if any collects here it will merely form a dam, over which the water will pass safely and fall into the well thus formed, whereas

with the other styles shown a complete blockade might occur; this is a matter of importance in wooded countries.

Stone culverts in cold climates are laid in cement mortar, including covers, and the paving is flushed with grout until full; and in all climates apron walls should be sunk two feet to three feet at each end, to prevent leakage along and under the walls and paving, otherwise the action of frost and undermining will both be destructive; but in mild climates such culverts are usually laid dry, and if attention is paid to the bonding and laying, the structure may last indefinitely. This class of work is shown on Fig. 32. Wherever the fall is rapid, paving should be laid beyond the lower end, as in Fig. 30, and may even consist of a very heavy flat stone floor, if the grade of the culvert is excessive. Culverts should, of course, be laid to the natural cross section, no matter how steep—in order to get the outlet low enough to prevent undermining, the direction of the discharging stream, in plan, is immaterial—water will get away somehow, but, in profile, there should never be an increase in the rate of fall, just below the lower end, unless on solid rock. If the foundation bed is solid, the cove which holds up the paving may be left of correct height to carry it, but if the foundation is poor, it will be best to build first a layer of concrete one foot to two feet thick, and commence masonry work and paving on this, or, in case the foundation is always to be under water, a grillage (platform) of timber will be suitable, as in timber box culverts.

Weak foundations are often the cause of failure on stone culverts, and all doubtful ones should be tested by the engineer himself, by driving an iron bar down in several places, but it is best to be on the safe side; a little

Plate IV

scale 1 in.=8 ft.

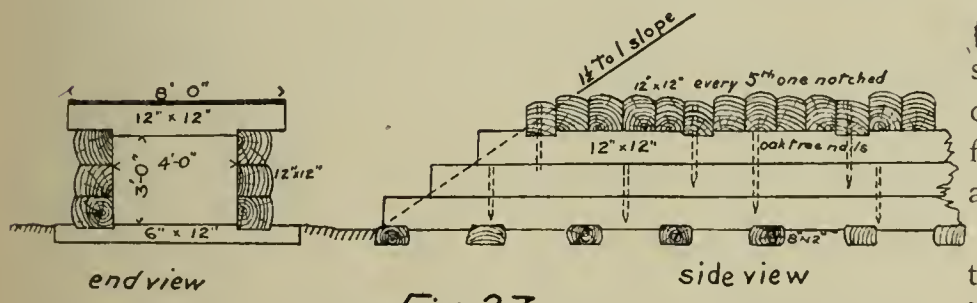


Fig. 27.
3'x4' Timber Culvert.

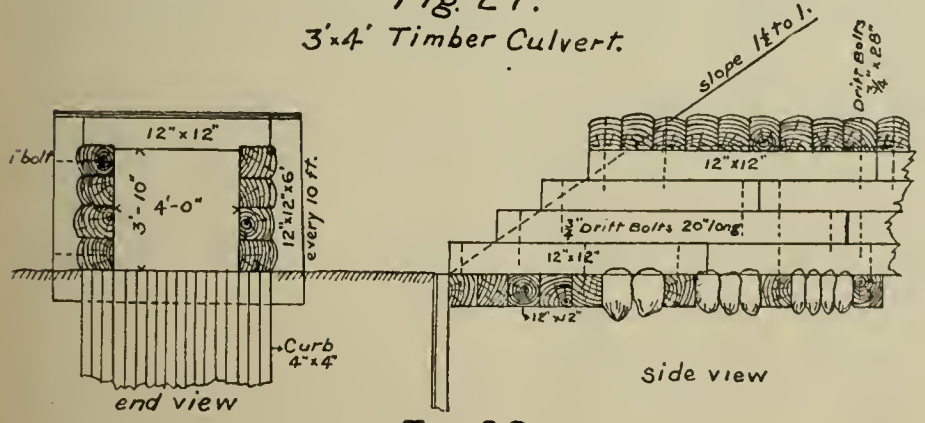


Fig. 28.
4'x4' Timber Culvert.
(C.P.R.)

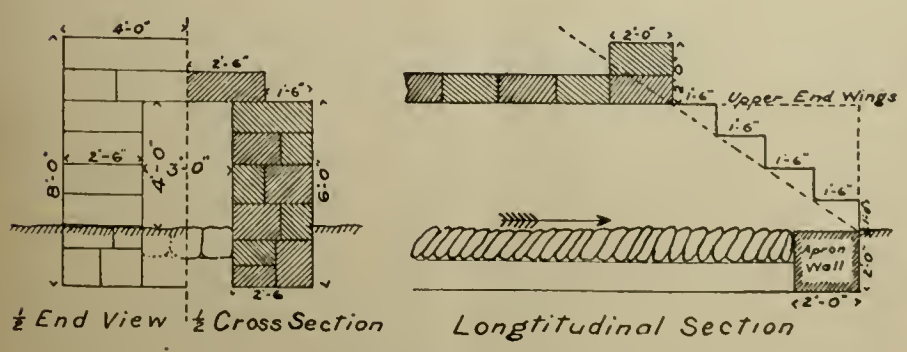


Fig. 29.
3'x4' Masonry Box Culvert.

Plate V.

scale 1 in-8 ft.

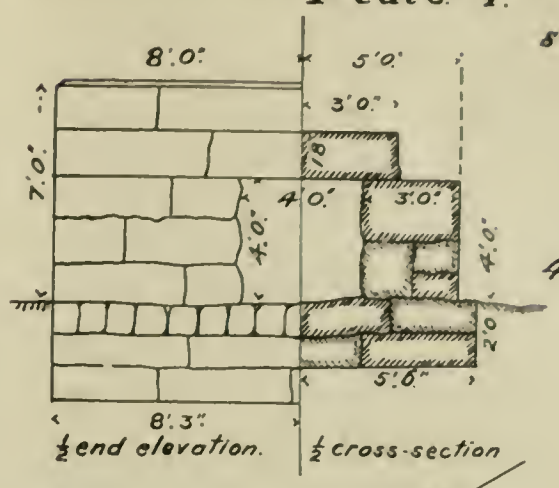
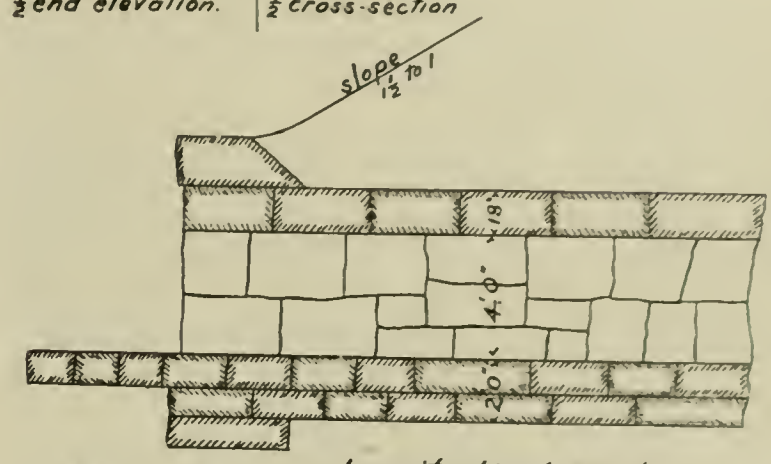
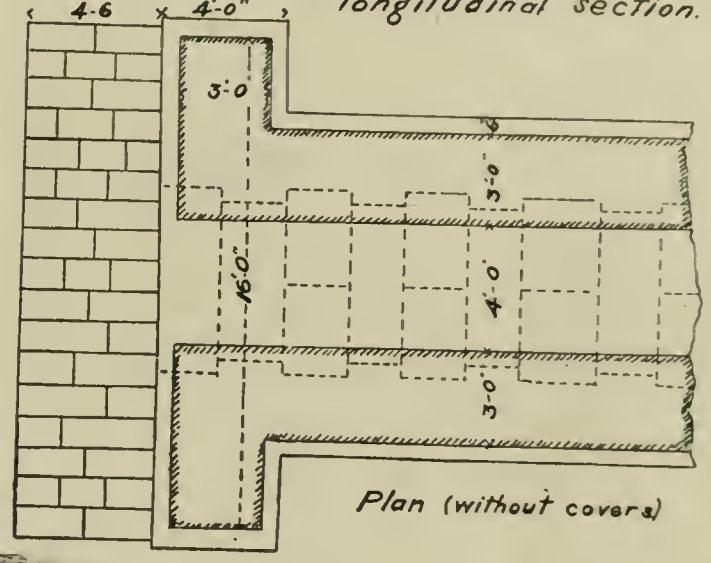


Fig 30.
4'x4' Masonry Box Culvert.



longitudinal section.



Plan (without covers)

sediment on the paving will do no harm, and will be swept out at each storm, whereas if the discharge end is too high, first a hole is worn, and finally the lower end is undermined and falls down.

If possible, culverts should be located at right angles to the centre line, and this can usually be done by diverting the entering stream, and using the material in the embankment adjacent. Skewed structures are expensive in many ways, more particularly, however, with arched culverts. The inspection of stone culverts during construction should be a rigid one, as rascally work can be hidden quicker in this class of masonry than in any other. Especially inspect the covers as to soundness and proper bearing on the walls, which should be from 9 inches on small culverts to 15 inches for large ones; they should have full bearings at each end, and be well spauled and mortared at the joints, to keep out earth and water. In bringing embankments against all culverts, care must be taken not to shove them over; filling should, if possible, be carried on on both sides at the same time, but if not, then earth should be shovelled over, up to the level of the top of the covers, before a high bank is brought forward. These remarks apply more particularly to arched culverts. The use of solid concrete box culverts to take the place of masonry ones is on the increase. They can be built cheaper, and when a knowledge of the science of cements and proper concrete making is more general, such construction will be largely adopted.

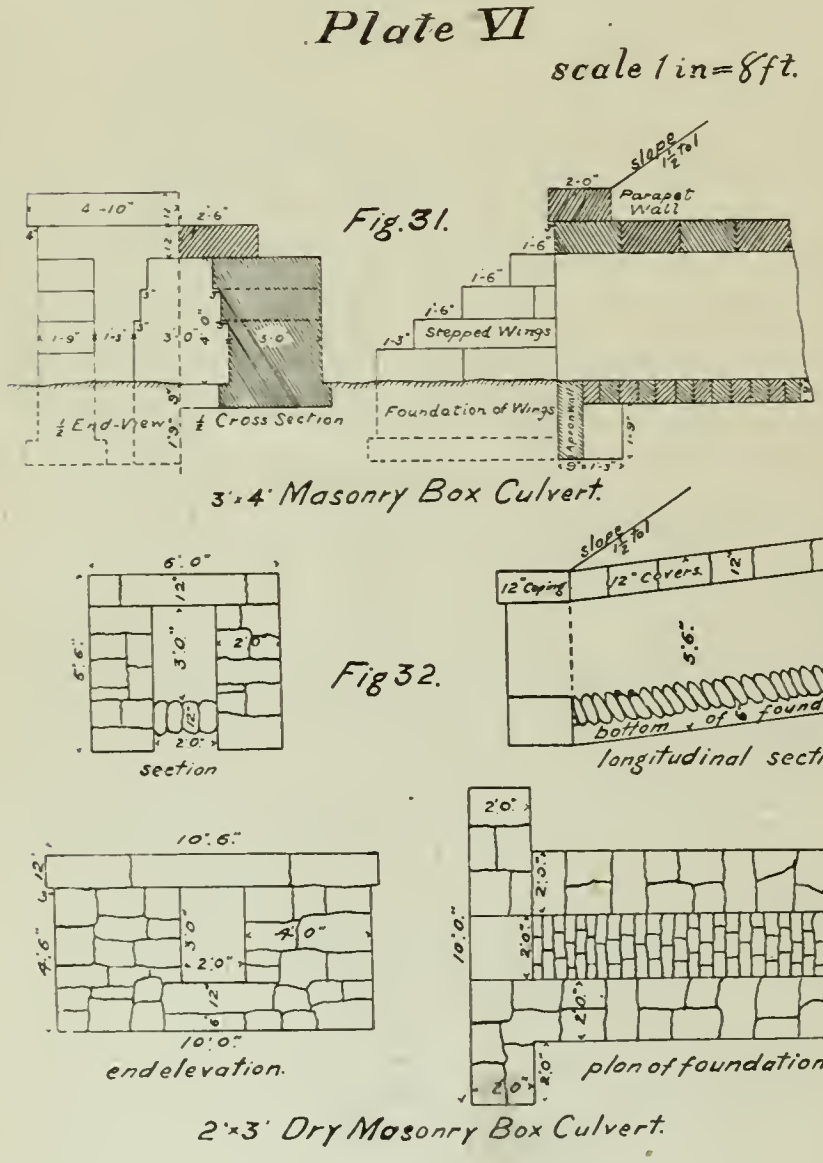
Specification for Stone Box Culverts laid in mortar.—"Culvert masonry shall be built of good, sound, large, flat-bedded stones, laid on their natural and horizontal

. The stones used must not be less than three feet in

area of bed, nor less than eight inches thick, and must be hammer-dressed so as to give good beds with half-inch joints or less. Headers shall be built in the wall from front to back, alternately, at least one in every five feet of wall and frequently in the rise of the wall. The least width of bed for stretchers shall be twelve inches. In larger structures, all stones must be heavier in proportion, every attention must be paid to produce good bond, and to give the whole a strong, neat, workmanlike finish. All dimensions must be according to plans, but these may be varied if the engineer so requires."

"The paving shall be of stone set on edge, twelve inches deep, packed solid, of an even face, and inclined in direction of the stream."

"The mortar shall consist of one part good quality Portland cement to three parts of clean sharp sand, and all joints, beds and interstices shall be carefully filled with mortar and packed solid—the exterior faces and interior of barrel shall have all joints raked and pointed with mortar, consisting of one part cement to one part sand."



Cost of Box Culverts.—Taking timber in place, including iron and foundations at $25 per M.B.M., culvert masonry at $6 per cubic yard, and paving at $3 per cubic yard, including foundations The cost of box culverts according to figures (28) timber, and (29) masonry, are given in table XIV.

TABLE XIV.

APPROXIMATE COST OF BOX CULVERTS (16 FOOT EMBANKMENTS).

Structure.	Waterway.	Total cost for depth of top of paving below subgrade. 10 ft.	20 ft.	30 ft.	40 ft.	50 ft.	60 ft.
		$	$	$	$	$	$
Timber Box..... Fig. 28.	2′ x 3′ high	183	306	429	552	675	798
"	3′ x 3′ "	213	356	500	643	787	931
"	3′ x 4′ "	234	397	560	723	886	1,049
"	4′ x 4′ "	263	446	629	812	995	1,178
"	4′ x 5 "	281	483	686	888	1,091	1,294
Stone Box ..... Fig. 29.	2 x 3′ "	254	420	587	754	920	1,086
"	3′ x 3′ "	267	444	620	797	974	1,151
"	3′ x 4′ "	364	607	851	1,094	1,338	1,582
"	4′ x 4′ "	385	645	905	1,165	1,425	1,685
"	4′ x 5′ "	501	848	1,195	1,542	1,889	2,236

From which table it is evident that the stone culverts increase in cost much more rapidly than the timber ones, owing to the necessary increase in the thickness of the stone walls, being estimated at 2 feet, 2½ feet and 3 feet thick for culverts 3 feet, 4 feet and 5 feet high (in the clear) respectively. It does not pay, evidently, to build small timber culverts, other things being equal.

For THE CANADIAN ENGINEER.

THE DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON, TORONTO.

An efficient refuse destructor is a desirable adjunct to the sanitary equipment of towns, and it is cheering to observe that the science of designing and the methods of constructing refuse furnaces has lately made rapid improvements, with the result that any kind of towns' refuse, including excrement, can be quickly and thoroughly burnt without the assistance of fuel. However foul and loathsome the material that is consumed may be, the fumes and smoke will be totally burnt up, instead of being discharged into the atmosphere, which was formerly the rule. A large amount of heat at a temperature of about 2,000° F. is created, which may be used to raise steam for generating electricity for pumping sewage, grinding mortar, crushing stone and clinkers, or any other useful or profitable purpose. Thus ensuring a saving of public health and money.

Some years since Professor Kennedy jokingly asked "How much steam could be raised from a pound of muck," meaning wet filthy refuse, street sweepings, excrements, etc. Geo. Watson, engineer, Leeds, England, and many others have during the past ten years clearly demonstrated that a furnace can be built that will raise one pound of steam for every pound of refuse destroyed, and maintain pressure of 140 pounds.

By studying the laws of creation we find that everything must be active to be useful, and that when activity ceases vitality ceases also, and whether the substance be a living body, or a volume of water, air or gas, when activity stops it becomes offensive and useless. Moreover, every thing created, however mean, small, or repulsive it may appear to us, is for some specific purpose. This is just what is done by gathering up the rejected refuse and filth of towns, and handling them in such a way that the poisonous gases they generate are destroyed and the unhealthy material turned to profitable account.

There are several kinds of refuse. In many towns there are privy pits, or the pail system of water closets, the contents of which have to be disposed of. The scrapings of macadamized roads are suitable only to mix with earth on productive land. Broken glass and crockery can be crushed small and used in place of marble or granite chips for mixing with concrete or asphalt work. Old tin after passing through the fire and the solder has been melted off, can be sold to manufacturing chemists or iron works along with the scrap iron picked out. The brass, copper, lead, and other valuable metals can find a ready and profitable market. Old paper and cotton rags can be easily made into common brown paper by erecting a small mill adjoining the destructor plant, as in Chelsea, Eng., without creating a nuisance, or jeopardizing the public health, The woolen rags may be steamed and afterwards

sold to woolen or shoddy manufacturers. Old boots find a German market, where they are brought to a pulp and molded into trays and fancy ornaments. Old rubbers can be reduced and made over into useful articles. Whole bottles may be cleaned and sold for use. The blood from slaughtered animals can be manufactured into various materials and for several chemical purposes. The fat is rendered into tallow, and the excrements manufactured into a portable inoffensive and valuable manure. The ashes should be sieved through a quarter-inch mesh, and then immersed in water, resieved and the clinkers sorted out, and the residue will then be a fuel almost equal to coal. This goes by the name of washed carbon. The dust dropping through the sieve may be mixed with the contents of privy pits, or the sweepings from paved streets, and sold for manure with the crushed bones. Objectionable material of all kinds that cannot be handled without risk to health, should be consumed in the destructor along with the vegetable and fibrous garbage.

The town council of Cardiff, Wales, has estimated the quantity of each kind of refuse collected in one year, and its selling value in that town :—

Broken crockery, 157 long tons, at	1	shilling	£	7	17 0
Scrap iron, 60 long tons, at	30	"		90	0 0
Old tins, 227 long tons, at	20	"		227	0 0
Broken glass, 137 long tons, at	30	"		205	10 0
Straw and fibrous, 927 long tons, at	20	"		927	0 0
Waste paper, 1,232 long tons, at	40	"		2,464	0 0
Rags, 113 long tons, at	60	"		339	0 0
Coal and coke, 240 long tons, at	5	"		60	0 0
Small cinders, 18,334 long tons, at	2½	"		2,291	15 0
Fine dust, 5,611 long tons—No value.					
Animal and vegetable refuse made into a special manure, 1,325 tons, at	20	"		1,325	0 0
Bones, 138 tons, at	75	"		517	10 0
Bottles, 12,500 dozen, at 3d. per doz.				156	5 0
			£	8,610	17 0

In addition to these, there is the heat generated in the destructor furnace, which will raise steam that can be used for power, and is useful in many other ways. The residue from the furnace can be used for building foundations for roads and sidewalks, making cement slabs suitable for paving, etc. ; in fact, everything can be made to serve some useful purpose. Bad meats, fish and flesh of all kinds, can be ground and steam-dried by a revolving machine that reduces it to a fine dry powder, making a fertilizer of great value. All this can be done by experienced workpeople in works situated in the centre of a dense population, without the slightest injury to their health ; but such works would be a danger and a nuisance, besides a bill of costs to the town, if they were not intelligently managed, with strict rules and cleanliness. From the financial side of refuse disposal, there appears to be nothing to hinder towns from paying a considerable amount of their management expenses from the rubbish the inhabitants throw away, and that gathered in the streets.

Along with an engineer, who for twelve years has been in charge of large boilers and engines where the steam is raised from wet sawdust and the bark from wet saw logs, I visited the West and East End Toronto refuse destructors, which, when properly named, are roasting ovens. They are built on the bakers' oven pattern, but in place of the floors being brick, they are covered by a coarse fire grate having an ash-pit underneath. There is one oven about eight yards long and three yards wide erected on each side of the chimney. At the end (and on the same level of each oven) furthest from the chimney, there are three coal furnaces, and either one or two on each side, making at least five in all for each oven. These are fired with coal, the fiery gases from all the furnaces enter the oven and make a bee line to the chimney, keeping the crown of the arch at a blood-red heat during their passage across the length of the oven to the outlet flues. And it is safe to assume that the heat from the coal fire enters the chimney at nearly the same temperature that it leaves the fire, which to my mind is a wilful waste of fuel. Destroying the refuse seems to be a secondary consideration here, and the destructors or ovens are not worked to anywhere near their capacity. They only handle the most inflammable portion of the city's refuse. The workmen say they cannot do more, because the chimneys cannot stand the heat. If this is so, the heat ought to be put to some useful purpose and not wasted in the atmosphere. The workmen might do a fair amount of work and place the garbage in the ovens at periods of not over thirty minutes each, in place of twice or thrice each day, keeping the receptacle nearly full and equally spread over the whole of the fire bars. By charging in that way the top layer would be drying and the bottom would be at a fierce heat, and the ovens would easily carbonize and even burn fierce enough to make clinkers without the aid of the present coal furnaces. Why they use coal can only be answered by assuming that they prefer the expense. When I was at the West End destructor not half the grates were properly covered, and they were broken and out of place, so that there were holes that a boy might creep through, and the whole surroundings were dirty, disorderly and unhealthy. At the East End destructor everything was clean and tidy. There was no reason apparently why it should ever be dirty, for there was very little in the ovens, nothing whatever on the filling floors, and nothing about the place but the attendants, with the doors fastened. If the Toronto destructors are a sample and a precedent for our smaller towns to copy, the consumption of coal will be sure to increase.

There are about five kinds of high-class refuse destructors on the market worthy of notice, each having some good points, and when erected by careful workmen, with good brick and fire-clay, are almost everlasting, and seldom need repairs. When erecting brickwork that will have to resist a fierce heat, the fire-clay mortar should be boiled and used hot, about the thickness of cream, and each brick should be made to fit tight to its neighbor throughout the full width so that a knife blade cannot penetrate. I have seen some of these destructors in working order, and will try and explain them before I finish this subject, but will first explain that simpler methods of disposing of garbage to profit can be used. To my mind the fibrous and vegetable garbage similar to what appears to be burnt in Toronto, and what is necessary to be burnt in most of our small towns, together with bad meat, fish, etc., could be burnt and used in exactly the same way that steam is raised to drive saw-mills by burning the heavy, wet sawdust and log bark, and if garbage is not so inflammable as the wet sawdust, a forced draft could be introduced under the fire-bars that would increase the combustion. It is only a matter of making suitable grate and blast arrangements.

Cook's system is used for destroying the bagasse or refuse from the sugar-cane crushing machines which contains over 60 per cent. of water, 6 per cent. of sugar, and the balance fibrous wood, and the heavy wet sawdust and bark from the cutting of sawlogs direct from the pond, which are little more inflammable, if any, than the light refuse collected from the dust bins of a town, or such garbage and refuse as cannot be used for manure, or roadbeds, or filling useless cavities.

Cook's furnaces which raise steam to run the factories without the use and expense of other fuel are constructed

in the following way: "All the boilers needed are set side by side on the same level, at an elevation sufficient to allow of a deep fire-box and ash-pit, and room enough for an iron barrow to stand under the bottom of the ash-pit doors, all below the bottom of the outer shell of the boiler. In the front of each boiler, a firebrick fire-box is built about four feet square, or six feet long by four feet wide. The grate bars are fixed about four feet below the point where the hot gases leave the vault to pass under the boiler. At the extreme end of the boiler, there is a combustion chamber; from this chamber the heat passes through the tubes in the boiler, after which it passes through and between the economizer or water heater, which supplies the boiler with hot water, then to the chimney, which it reaches at a temperature of about 600° F. I believe with the German scientist Seimens, that if the fire pit be some distance away from the face of the boiler that the fuel will give better results, because it will cause more flue room for the better mixing and combustion of the gases, especially if there are bridges thrown across the flue to break and split up the flames. It would improve the heat still more if a current of heated air could be introduced into the centre of this combustion chamber. It would help to re-burn the moving gases, and increase the heat of the flues. This could be done by carrying an air flue through the centre of the fire box walls. A small 2-inch pipe would do, and it would take sufficient heat from the hot bricks to warm the air passing through. This fire box is extended over four feet above the point where the heated gases leave the fire vault, to pass out towards the boiler. Some of the vaults are covered with heavy iron plates having hinged doors that can be lifted, and a horse cart or railway car load of refuse tipped in at once. However wet the refuse may be, it dries quickly, and the steam it throws off is drawn down and consumed by the fierce heat at the bottom of the fire box, and in the carrying flues, so that before it is lowered down to a point parallel with the boiler flue, it becomes a red burning mass, and another wagon load is tipped in on the top of it. So the process should go on continually night and day when using towns' refuse and garbage.

I have explained this furnace arrangement sufficiently for the reader to understand its advantages, which comes in short to this: that any town can run its own electrical lighting plant, sell electrical power to its manufacturers, pump its supply of water or lift its sewages by erecting suitable plants and using the garbage, refuse and sweepings of the town for fuel, thereby purifying the town's atmosphere, increasing its sanitary qualities, and reducing the sufferings of its inhabitants from disease. The fumes and smoke of the furnace can be completely burnt by having properly arranged flues and secondary combustion chambers, and by using a good steam blast, which, according to Mr. Estcourt's (the public analyst) report, raises the carbonic acid gas from 2 to 14 per cent. The analyst's report of gases generated from rough towns' refuse, including ashes, excrement, sweepings, etc., is carbonic acid 14.6, oxygen 5.4, nitrogen 80.0. The value of coal is about 14.200 units of heat for each pound of coal, which will evaporate 14.70 pounds of water. Two and a-half pounds of dry wood of any kind, of dried bagasse, or dried tanbark, have the same steam-raising quality as one pound of coal. Straw, $3\frac{3}{4}$ pounds; peat, when dry, two pounds, is equal to one pound of coal. I have been told that the horse street railway of Chicago supplied the fuel used for raising steam to run the cable road from the horse litter, with the addition of a small quantity of coal.

The rough wet refuse or garbage collected in towns during wet weather, or excrements mixed with coal ashes or dust and droppings swept from paved streets will contain about 60 to 70 per cent. of moisture, and taking that into consideration, the value of town refuse is about ten pounds of refuse, equal to one pound of coal for steam raising purposes. The total amount of refuse averages about two pounds per head, per day, the year round, equal to seventy-three pounds of coal per head, per year. This, allowing the population of Toronto city to be 190,000, would make the refuse, if burnt in a first-class destructor with the latest designs of steam blowers, equal to 13,870,000 pounds, or 6,935 short tons of coal per year, or 19 tons per day, which is abundance of heat to raise enough steam to pump our water supply, saving the city over $28,000 per year. The pumping station is both a central and suitable place to build a destructor of first-class type, easy to get at; for the carts could go level off the Brock street bridge on to the top of the furnaces to deliver their loads.

To be continued.

REPORT OF THE CANADIAN DEEP WATERWAYS COMMISSION.

The agitation for deep waterways from the Great Lakes to the Atlantic by other than existing routes, has been going on for many years. The first convention to discuss plans of the proposed work was held at Burlington, Vt., in 1849, where it was proposed to connect Lake Champlain with the St. Lawrence by a canal larger than the Chambly. The Caughnawaga Canal was surveyed by the Government some forty years ago, but opposition on the Canadian side, and the fact that no similar outlet existed from Lake Champlain to the Hudson, prevented the construction of this work.

After a dozen conventions had been held, at various United States cities and in the lake region, a Deep Waterways Convention was called by the city of Toronto, in 1894, to which representatives from the United States lake cities were invited. The International Deep Waterways Association was formed, which held its first convention at Cleveland in 1895, and from whose proceedings the Act of Congress creating an International Commission originated.

It is impossible to convey, within reasonable space, an adequate idea of the extraordinary development of inland water transportation on the upper lakes—which, for rapidity, extent, economy and efficiency, has no counterpart even on the ocean. More than half of the best steamships of the United States are imprisoned above Niagara Falls, and more than half of the tonnage built in the United States in 1896 was launched upon the lakes. This inland water commerce has built up twelve cities on the southern shores above Niagara, five of which have over 200,000 population, one over a million, and the remainder above 20,000 each, and within these same limits there are 27 dry docks, the largest of which is on Lake Superior and is 560 feet long, 50 feet wide, with 18 feet water. There are 63 life-saving stations upon these lakes, ten of which are Canadian. Of the 53 United States lake stations, all but five are above Niagara. The economy of this inland water transportation is the result of deep water primarily, and, in the second place, of practically unlimited dimensions in other respects for the vessel; there being but the lift of one lock (of ample dimensions) to reach Lake Superior, and none at all between Buffalo and Chicago.

The large cargo steamers, with triple expansion engines, show a coal consumption (for the best practice) of 2 lbs. per developed horse-power per hour. Actual runs give four-fifths of an ounce of coal per mile consumed per

ton of cargo carried. Economy results from special port facilities, by which loading and also discharging is effected largely by mechanical means. A typical freight steamer is 432 feet over all, 48 feet beam and 28 feet depth (180 feet too long, 4 feet too wide and much too deep for the Welland Canal) and is double bottomed, with compartments into which water ballast can be admitted or pumped out; with triple expansion engines, cylinders 24, 39 and 63 inches in diameter and 7 feet stroke, supplied from boilers carrying 160 pounds working pressure. It carries over 5,000 gross tons iron ore on 16 feet 10 inches draught of water. The total United States lake feet (including that upon Lake Champlain) in June, 1896, was nearly 3,000 vessels of about 1,300,000 registered tonnage, over 1,800 of which are steamers with about one million registered tonnage. There are 300 of these above Niagara (embracing all the finest vessels of the lakes) which are too long to pass the Welland Canal locks. More than half of these are built of steel and iron, and, of the last fifty built, forty-one were of steel and only nine of wood.

The traffic in iron ore is the chief feature of the lake trade. It is estimated that 75,000,000, tons of ore have been transported on the lakes in the past ten years. Sixty per cent. of the iron ore used in the United States is carried on the lakes. The lumber and coal trade come next in volume to the ore trade. Every reduction in transport charges will enormously increase the amount exported. Each reduction extends the area of cultivation in those districts (like the Dakotas and the Canadian prairies), which are dependent on the Lake Superior route, and also extends the area of attraction towards the lake route from the more southern districts having a choice of routes to the Atlantic. The unfortunate position which Montrea occupies, owing largely to the shallowness of the present waterways, is shown by this statement from the report. All of Buffalo's ten million barrels of flour came by lake. Of Montreal's million and a half, only 133,000 barrels came by the St. Lawrence, while 267,000 barrels went to Ogdensburg by water. Of the total movement to tide-water of 150,000,000 bushels of wheat and flour, Montreal received about 11 per cent. Of the total movement to tide water of 107,000,000 bushels of corn, Montreal received about 6 per cent. Of the total 19,035,377 barrels of flour received at tide-water, North Atlantic, Montreal received 8 per cent. Buffalo has 52 elevators including transfer and floating ones, 16 million bushels storage capacity, and 6 million bushels elevating capacity in 24 hours. The transfer charges there upon wheat are $1\frac{1}{8}$ cents per bushel, and in New York $1\frac{3}{8}$ cents.

Experience with large vessels on Lake Erie between 1880 and 1890, and up to date, having been to reduce previous rates of freight between Buffalo and Lakes Superior and Michigan, about one-half (representing many millions of dollars saved in transportation charges), has convinced the representatives of the capital engaged in the commerce of the upper lakes, that an extension of deep water to the Atlantic seaboard will effect an annual saving of more millions than will be required to pay the interest on the cost of such a work, great as that may be. It is also evident from the foregoing that such a waterway would only be undertaken upon the best route to New York, and Canada's interest in the question is, whether that will be an international one. There is only one international route possible, says the report, which is that via the St. Lawrence and Lake Champlain, which is also one which permits of the extension of this deep water system to Montreal, and thence to Europe, on the shortest possible line. This fact, together with the consideration that the St. Lawrence-Champlain route gives the greatest extent of wide and deep water, the least mileage of artificial channel, and the minimum of lockage, has given rise to this International Commission. Canada's interest in such a waterway is only second to that of the United States. It would give an opp rtunity of doing what our canals were intended to do, but have failed to do; that is, to obtain the maximum amount of the western trade for the St. Lawrence route; and, in addition, it would afford a most direct navigation upon the largest scale between Montreal (as well as the Ottawa) and Lake Champlain, with its New England frontier, and with the Hudson River and New York, as also the most economical connection possible with Chicago, Duluth, and Fort William, on Lake Superior.

In a preliminary report made to the Government in March, 1896, the commission reported that the canal from Lake Erie to Lake Ontario would be most advantageously built in United States territory, as satisfactory plans could not be prepared for a channel of the contemplated dimensions to follow the summit level of the present Welland Canal. To attempt this, the work would have to be largely done in winter at greatly increased cost, and its execution would interfere with the free working of the existing line of navigation and endanger its structures. It is, therefore, to be presumed that an enlargement necessarily involving such risks would not be sanctioned by the Government.

The series of canals between the Galops Rapids and Lake St. Francis are being built for fourteen foot navigation along the north shore of the river, and are now, as a whole, well advanced towards completion. From his knowledge of the location and construction of these canals, Thos. Monro, C.E., considers it to be quite inadmissible to permit an attempt to be made to deepen them to twenty feet or more, for similar reasons to those above stated in reference to the Welland Canal. A reconnaissance has been made, and a few levels taken serves to indicate that the United States, or south side of the St. Lawrence, offers a fair site for a deep waterway from the head of the Galops to Lake St. Francis, opposite Cornwall.

The proposed deep water channel passes in Lake St. Francis from McKie's Point to Hungry Bay, where the St. Francis-Champlain Canal is to leave the lake. The line which it is proposed to follow between Lake St. Francis and Lake Champlain runs in an easterly direction across the depressions or valleys of the St. Louis and Chateauguay rivers, and after skirting the high ground near Ste. Philomene, bends almost due east and strikes for St. Johns on the Richelieu River—the total length of main canal being about 50 miles.

The final report of the commission, made after a meeting with the United States Deep Waterways Commissioners, at which the final report of that body was also presented to the joint commission, asserted the entire feasibility of constructing a deep waterway adequate to any scale of navigation which may be required between the several great lakes and the sea-board; and, also, that it will be wise to provide for securing a channel of a navigable depth of not less than 28 feet.

"The most eligible route" is declared to be by the Niagara River, and by canal, on the east side, from Tonawanda to Olcott on Lake Ontario; that the sea-board may be reached (from Lake Ontario) by the St. Lawrence River; and that the American sea-board may be reached by the St. Lawrence River, and via Lake Champlain to the Hudson River, or by way of the Oswego, Oneida-Mohawk Valley and the Hudson River. The impossi-

bility of the Oswego route, which has been set forth by Major Symons, will be found on another page. The report is signed by O. A. Howland, Thos. Munro, Thos. C. Keefer.

OUR RECORD.

DOMINION OF CANADA: PROVINCE OF ONTARIO. County of York. To wit: } In the matter of the circulation of THE CANADIAN ENGINEER.

I, Alfred Wesley Law, of the city of Toronto, in the county of York, do solemnly declare that—

1. I am the secretary-treasurer of the Monetary Times Printing Company of Canada, Limited, which company prints THE CANADIAN ENGINEER for Biggar, Samuel & Company, and as such have personal knowledge of the matters herein deposed to.

2. That the following statement correctly shows the number of copies of THE CANADIAN ENGINEER printed and mailed on the dates hereinafter mentioned, that is to say :

Date of Issue.				Copies Printed and Mailed.
Volume III., No.	1,	May,	1895	2,000
" "	2,	June,	"	2,000
" "	3,	July,	"	2,100
" "	4,	Aug.,	"	2,200
" "	5,	Sept.,	"	2,400
" "	6,	Oct.,	"	2,400
" "	7,	Nov.,	"	2,500
" "	8,	Dec.,	"	2,600
" "	9,	Jan.,	1896	3,500
" "	10,	Feb.,	"	3,000
" "	11,	March,	"	3,100
" "	12,	April,	"	3,150
Volume IV., "	1,	May,	"	3,250
" "	2,	June,	"	3,450
" "	3,	July,	"	3,600
" "	4,	Aug.,	"	3,450
" "	5.	Sept.,	"	3,975
" "	6,	Oct ,	"	3,725
" "	7,	Nov.,	"	3,800
" "	8,	Dec.,	"	4,050
" "	9,	Jan.,	1897	4,100
" "	10,	Feb.,	"	4,350
" "	11,	March,	"	4,350
" "	12,	Aprii,	"	4,350
Volume V., "	1,	May,	"	4,350
" "	2,	June,	"	4,000
" "	3,	July,	"	4,350
" "	4,	Aug.,	"	4,400
" "	5,	Sept.,	"	4,500
" "	6,	Oct.,	"	4,400
" "	7,	Nov.,	"	4,600

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of "The Canada Evidence Act, 1893."

A. W. LAW.

Declared before me at the city of Toronto, in the county of York, this fourth day of November, A.D. 1897.

W. H. MOORE,
Commissioner, etc.

To each of the first two persons sending us The CANADIAN ENGINEER of September, 1893, we will pay 50 cents, or one year's subscription.

A GREATER THAN STANLEY.

Canada has all reason to be proud of William Ogilvie, assistant astronomer to the Dominion Government. As we will be prepared to show in another issue, Mr. Ogilvie, as an explorer, is a greater man than Henry M. Stanley, the African explorer, because he has encountered and surmounted greater difficulties, has traversed a greater extent of unknown country, has opened a greater field for colonization, and pointed the road to greater wealth. More than this, he is absolutely free from that insufferable egotism which made Stanley personally offensive to many who knew him and had to serve under him.

Mr. Ogilvie has returned to Ottawa, where he is now busy preparing his special report, to be published early next year. On his way through Toronto he favored THE CANADIAN ENGINEER with a short conversation, some points in which were repeated at his most interesting talk before the Canadian Institute. One of the valuable points which he was generous enough to give to the mining readers of THE CANADIAN ENGINEER refers to the mechanics of mining in the Yukon. As the climate of the Klondyke may be said, to use the words of a pioneer, to be "nine months winter and three months late in the fall," hydraulic mining is out of the question. Where the thermometer ranges below zero so long, and the rivers are beds of ice, quartz mining will have to be conducted on a new plan. He suggests, therefore, a system of dry crushing, and a separation of the gold by a modification of Edison's plan of magnetic iron ore extraction. Of course, the magnet has no attraction for gold ; but the gravity element of Edison's plan could be used by having chutes from which the crushings would be ejected, the greater gravity of the gold causing the precious metal to be thrown farther than the particles of rock, so that the greater part of the gold would be found in a heap at one end. There would be an intermediate space in which more or less gold would be found mixed with the rock, but this could be treated by the present amalgam process. An alternative plan might be a process of winnowing. Mr. Ogilvie gives the idea of the gravity system for the benefit of miners, leaving it to the mechanical engineers to work out the details of the machinery. Another very valuable suggestion he makes, which can be applied to the present placer mines, is the use of steam instead of fire in thawing the ground. The following conditions prevail in the placer diggings all through the Klondyke : for the first six to twelve feet the miner goes down through what is called "muck," that is, decayed leaves, and other vegetable matter, embedded in a network of tree trunks and branches. Then coarse gravel is encountered several feet in depth, and at the bottom of this gravel, lying on the more or less crumbled flags of the so-called bed-rock, the gold is found, nearly all of it lying within two to four feet of the rock surface. Now all this material of muck and gravel is frozen solid at all times of the year, and has to be thawed out foot by foot by building fires each day, the daily fire only penetrating the distance of about a foot. When the rock is reached the miner thaws a tunnel horizontally along the surface of the rock in the direction where the best pay gold is found, but it is not safe to penetrate more than twenty or thirty feet in either direction from the vertical shaft because the tunnel cannot be ventilated. Now, the use of steam in thawing the gravel would not develop any poisonous carbonic acid gas, but in fact would help purify the air, while the steam thawing would enormously increase the amount of work that could be done in a day. All that would be required in this process is a simple type of boiler, and a steam hose-pipe and nozzle. Mr. Ogilvie

proposes to demonstrate the advantages of this plan by having a sample steam-thawing outfit manufactured and tested.

An important point brought out by Mr. Ogilvie, but which is not generally known, is that, by the treaty between Great Britain and Russia in 1825, all the bays, inlets and rivers extending through the Alaskan strip are open freely to navigation by Great Britain forever, so that there can never be any question of the right of Canadians to the use of the Skagway and other water inlets to the Klondyke.

In an area of thirty-five miles long by fifteen miles wide in the Klondyke, Mr. Ogilvie assures us that there are at least $100,000,000 worth of alluvial gold, and as he has proved that the pioneer miners of this region were Canadians or Old Country men, he believes that this vast wealth should be got by Canadians and kept in this country. This is the true spirit, and if the majority of Canadians were of the Ogilvie stamp, not much of the wealth of the Klondyke would be lost to Canada. The available timber of the Klondyke is being rapidly used up, but it is comforting to know from Mr. Ogilvie that over a large extent of country there are frequent outcroppings of semi-bituminous coal of a good serviceable character, and providentially these large seams of coal run parallel with the gold deposits, many of them being right along the river, where mining can be carried on cheaply. Still another remarkable fact is, that along with the coal and gold in convenient proximity, there are ample deposits of limestone, affording all the flux wanted in smelting. Both coal mining and quartz mining will commence in 1898, when at least 100,000 men will be working in the Yukon region. Cone Hill, in the Yukon, appears to be one vast mountain of gold-bearing quartz, far surpassing the Treadwell mine in richness. Some samples of quartz gold, which Mr. Ogilvie tested in a hand mortar, yielded as high as $1,000 per ton. In addition to the gold and coal, galena has been found in various places, and in the serpentine rock there is much low grade asbestos. Besides these minerals, an Indian recently brought in a block of pure copper, and when the source of this can be found another element of great value in these days of electricity will be disclosed. Of course, everyone will not get rich who goes to the Yukon. It will take energy and perseverance to develop these resources, but Canadians, with the help of British capital, are the people to do it.

TORONTO'S FOLLY.

"*I will not give such a permit to the Mayor himself, nor to any member of the council.*" Reply of E. J. Lennox, to a representative of THE CANADIAN ENGINEER, who asked for a permit to view the new city buildings in order to write an article, which was to be one of a series on the municipal works and plant. The reason given was: "*The plans are being changed from time to time as obstacles arise,*" and further, "*I have the right to make such changes as I see fit.*"

At this time when the annual inquiry into the new Toronto city buildings and the city architect is being carried on, and public attention is being centred on the building operations, being conducted under lock and key on Queen Street, it has been thought wise to go somewhat into the history of the whole matter. It is unpleasant to tell the people of Toronto that the many delays in construction have not been made entirely that we might have a better city hall. It is harder still to discover that the city must pay much more before the building is completed, but it is hardest of all to find out that even then it will not be the pearl among city buildings we had fancied. Much credit has been given to the architect for the beauty of the design. We will give him less in future, however, when we study the elevation of the Pittsburg, Pa., Court House and County Buildings, which appears side by side with that of the Toronto City Hall on this page. Had the people of Toronto all visited Pittsburg in the last twelve years as Mr. Lennox has, they would, probably, have wanted the tower in the centre of the building, as it is at Pittsburg, instead of looking down Bay street, which

CITY AND COUNTY BUILDINGS, PITTSBURGH, PA.

is the reason given for moving the one in Toronto. The whole mass of the building is very like, but is still unlike the work of the great Richardson, at Pittsburg. Where is the grand simplicity, the enormous scale, the perfect symmetry? It will always be a matter of regret to the people of Toronto, that Mr. Lennox did not go to Pittsburg oftener, stay longer, and "study" harder.

In 1884 it was decided to erect a new court house in Toronto. On December 20th of that year circulars were sent out to the architects calling for plans to be placed in competition, the author of the successful plan to be given the erection of the building. The cost of the proposed court house was limited to $200,000. None of the plans that were found desirable were within the sum stated, and all were returned to the authors and a new competition announced in May, 1886. The plan prepared by E. J. Lennox, the famous "No. 7," was accepted; the cost to be $200,000. It may here be stated that about the date at which all plans entered for the competition should have been filed, a delay of two weeks was granted, and for this step on the part of the committee no satisfactory reason has ever been given. At this time Ald. T. Hunter, who

TORONTO MUNICIPAL & COUNTY BUILDINGS
E. J. LENNOX, ARCHITECT

was subsequently clerk of the works for many years under Mr. Lennox, was chairman of the Court House Committee.

The court house to cost $200,000 was proceeded with and the contract for the excavations and foundations was let to Lionel Yorke, and when it was seen that this portion of the building alone was costing $111,000 a halt was called and the new scheme of incorporating the city hall with the new court house was brought forward. W. H. Howland, then mayor, in a message dated Feb. 15th, 1886, points out that the unsanitary condition of the city hall and the lack of accommodation there will shortly render a new building necessary. He says that the required building can be incorporated with the court house, "the expense will probably not exceed $100,000 in addition to the cost of the court house, while a new city hall on a new site, built independently would probably cost $300,000 or more." He adds: "It will not delay construction of the court house as the architect, etc."

The architect was instructed to prepare plans for the combined buildings. In April, 1887, the issue of debentures to the amount of $750,000 was authorized by the ratepayers, which was in addition to $300,000 already issued—the whole to be employed in building the combined court house, city hall, and police court. It was deemed advisable to examine the plans to see if all the requirements of the architect's instructions had been fully complied with. The committee of council wished to appoint an expert, to have the architect appoint another, and the third by mutual agreement. The city nominated Matthew Sheard, but on his stating that his fee would be $1,000 for such examination, the project is lost sight of in the minutes of council for some time, but presently emerges in the form of a laudatory report on the plans by J. J. Withrow, Thos. Snarr, and Ex-Ald. E. Galley. They had been instructed "to examine and report upon the specifications for the new court house and city hall buildings, as to their fully describing and specifying the different qualities of workmanship, materials, etc., also to report upon the different grades of stone available for the said building." These experts stated that they had "made a careful examination of plans and sections to find if they showed as fully as they should the manner in which the work was to be executed." Their examination included "excavation, masonry, rubble, cut stone, brick work, drainage (partial), carpenter and joiners' work, copper and galvanized iron work, and roof tiling." There was doubt in their minds only as to the clearness of the specification in the matter of the sources from which the building stone was to be obtained. This report as to the satisfactory nature of the plans was dated February 7th, 1887. When a representative of THE CANADIAN ENGINEER called on the architect, November 30th, 1897, he was informed that he would not be admitted to the building to make any observations, "AS THE PLANS WERE BEING CHANGED."

Joseph Wright, of the Bennett & Wright Co., and W. J. Burroughes, were employed to make a further report on certain portions of the plans. They conclude a lengthy and most laudatory report thus: "We find that the plans and specifications, as now prepared, are of a similar description of work as is now being adopted in other large public buildings through the United States, and we are of the opinion that if the work is carried out as set forth in the plans and specifications, that the city will receive a first-class job of plumbing, gas, heating and ventilating works, and one that will give general satisfaction." It is sad to reflect that it is these very plans of the heating and ventilating plant upon which Mr Lennox is now making such changes as are from time to time desirable. It must worry Mr. Wright to be engaged upon a work which was in the first place so carefully planned and specified, and which is now being changed. It is to be hoped that the sum of $107,925 which the city has contracted to pay the Bennett & Wright Co. for this plumbing, etc., over and above the $80,000 which was the amount of the tender opened Sept. 6th, 1888, will mitigate the annoyance caused by any change.

Report No. 4 of the Court House Committee, Sept. 6th, 1888, states that the following tenders were received and opened:—

Masonry, etc., Elliott & Neelon	$838,061 47
Copper, galvanized iron, etc., Douglas & Co.	7,900 00
Painting, etc., A. M. Browne & Co.	21,212 00
Plastering, C. R. Rundle	82,374 00
Wrought iron, etc., Dominion Bridge Company	91,150 00
Roofing, G. Duthy & Son	34,450 00
Carpenter R. Dennis	149,887 00
Plumbing, etc.,	80,000 00
Contingencies (estimated)	25,000 00
Furniture, architect (estimated)	75,000 00
	$1,405,034 47

Of these the masonry, copper work, painting, plastering, iron work and roofing, were let, and upon almost all of these the city has rendered itself liable to damages, owing to delays occasioned in filling these contracts which have arisen from time to time by reason of the action of the city or its architect.

The contracts, dated July 27th, 1889, require the work to be completed in three and a half years.

The delays were occasioned in the most various ways. The contractors charge that they did not receive the detail drawings from the architect in as short time as they should have done, and it has been established that when supplied the plans were in many cases defective. For instance, the foundation plan was found not to correspond with the excavation plan. The ground floor plan would not fit the basement plan, etc. The truth of this statement can be ascertained by examining the original drawings. Even at this time the plans were changed as "obstacles presented themselves." The contractor for the masonry was confined to one quarry, and its output was found unsuitable in some respects. The Credit Valley Quarry Co. which supplied the greystone found the demand exceeded its supply, and a fresh quarry had to be opened near Orangeville, Ont. The works were kept shut down for a large part of each year. The appropriations were exhausted and new ones had to be awaited. Recourse was had to litigation. Some of the contracts were let at much later periods than the rest, it being argued that during the delay prices might fall and the city would benefit. (The manner in which this worked out has already been shown in connection with the plumbing contract.)

Ald. E. A. Macdonald moved, seconded by Ald. J. Tait, May 17th, 1889, "that in view of the fact that the ratepayers are being called upon to vote upon a by-law to provide an additional sum of $600,000 for the erection of a combined court house and municipal building, and whereas the people have already voted $1,050,000 for that purpose, and whereas the public have no better assurance now that the $1,650,000 will complete the proposed buildings than they had that the initial appropriation of $300,000 would do so, etc., etc." Lost.

As the matter stands to-day, the people of Toronto are asked to vote a further large sum in the face of the heavy expenditures already made, of the fact that Mr. Lennox is still changing the plans, and that the original contractors, all and sundry, have undoubtedly rights of action against the city for damages, amounting in the aggregate to many times the proposed first cost of the building.

(To be continued in next issue.)

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ANNUAL DINNER, TORONTO NO. 1.

The 11th annual dinner of Toronto No. 1, C.A.S.E., was held at the Richardson house on Thanksgiving eve, and was in some respects the most successful yet held. Over 100 sat down to a well-filled and well-served table, and Mr. Richardson was complimented on the excellence of the provision he had made for the happiness of his guests. The chair was occupied by President G. C. Mooring, with his Worship Mayor Shaw in the place of honor. In introducing the toast list, President Mooring welcomed the members, and recalled the progress made by the association since the time, eleven years ago, when about a dozen of them met in Bro. Wickens' house to organize for work on the lines which time had shown were so successful. He then gave the "Queen," which was enthusiastically received with "God Save the Queen." "Canada, our Home," was coupled with the name of Geo. Anderson, of the Royal Oil Company, who gave an interesting account of his recent visit to Japan as Trade Commissioner for the Canadian Government. The last address he had given on the subject of Canada was in Yokohama, where the name of our country had been received with special honor. There, and in other Japanese cities, on the occasion of his addresses before commercial audiences, the flags of Britain and Japan were draped together, and on one occasion it was shown in fireworks with the skill and effect for which the Japanese pyrotechnists are noted. Everywhere he went information on Canada was eagerly sought, and if Canadian merchants and manufacturers had enterprise enough to take advantage of their opportunities, an immense trade would be developed between this country and Japan in the next few years. On his way to Japan he passed through British Columbia, and was greatly struck with the vast natural resources of that province. On a visit to one of the canneries he saw two scows brought up, loaded with 24,000 salmon each, and the contents of both scows were to be boiled and canned that afternoon. In going through the Douglas fir woods he saw a tree 300 feet high, 11 feet in diameter, and 90 feet high before the first limb was reached. As to the mineral wealth of British Columbia, he heard it stated in England that capital to the extent of £250,000,000 was now waiting investment in Canada, chiefly in British Columbia. In Manitoba the wheat exports alone were valued at $17,000,000, and of other grains, $3,000,000. The combined exports and imports of Canada now amounted to $260,000,000, which were greater per head of population than any other country, and it was a fact also that we spent more per head of population on education than any country in the world. In reviewing the extension of the ocean transportation facilities of Canada, it was a grand thing to be able to say that one could start at Yokohama, Japan, sail across the Pacific to Vancouver, and thence by rail to St. John or Halifax, and on by steamer across the Atlantic to Liverpool, entirely by Canadian steamships and railways. George Grant then roused the enthusiasm of the audience by his rendering of Godfrey's song, "Land of the Maple." At this point Mayor Shaw came in, and was received with tumultuous cheers. Harry Brown sang "Beer," which was encored. The toast, "Toronto, Our City," was replied to by Mayor Shaw, who apologized for the lateness of his arrival, by explaining that he had already been to two or three meetings, and expected to attend three more before he reached home that night. He came to thank the association for the honor they had done him in inviting him to reply to the toast of "Our City." He was himself born in Toronto, and if anyone had reason to be proud of the city it was he. For 13 years the people of Toronto had retained him as their chosen representative in the Council, and the aldermen, chosen by the people, had in turn elected him to the Mayor's chair, and he had this much faith in their appreciation of him that he believed they would elect him to the same honor in January next, and that he would have the pleasure of opening the grand new city buildings, which would be finished within the year. He referred to the compliments passed upon the Queen's Own Regiment that morning by General and Lady Gascoigne. He looked on Toronto as the fairest city in Canada, and considered it one of the best governed cities in the world. He did not consider the factories of a city so essential as some other things, but held that if more attention was paid to our streets, and some attractive drives made, that these attractions, with our unrivalled educational facilities and climate, etc., would make Toronto famous as a summer resort for Americans and others. He referred to the proposed big new hotel, and said that Toronto was growing surely, if slowly, and that the gloom of the former real estate collapse was now disappearing. James Fax, the comic singer, who has always been a favorite among the engineers, then gave a song, which was heartily encored. "The Manufacturers" was proposed, coupled with the names of John J. Main, of the Can. Heine Safety Boiler Co., F. H. Leonard, of the Toronto Electric Motor Co., and James McLaughlin, of the Queen City Oil Co. After a good song by John Lester, Mr. Main replied, and said that judging from the enquiries for steam power, manufacturers had a good year before them. He took issue with Mr. Anderson as to the possibilities of Canadian trade with Japan, and did not see how Canadian manufacturers could compete with a people who lived on rice and worked for a few cents a day. Neither did he agree with the theory of the Mayor that Toronto's prosperity depended on summer visitors. He considered the establishment of factories of far more consequence, as new industries would bring a permanent population of more value to a city's various interests. As for the interests of the country at large, if the Government saw to it that such products as nickel were not only mined, but smelted and manufactured in Canada, instead of being shipped out in a crude state to enrich foreign corporations, it would be much better than contemplating visions of imaginary foreign trade. Mr. Leonard followed, and said that while he agreed to the policy of beautifying a city, it took the wealth of manufacturers and the labor of mechanics to accomplish these results. He did not feel at home in discussing questions of manufacturing outside his line of business, but on the subject of electricity he could say that there never was a time when so many important electrical developments were being made as within the past few years, and the progress made by Canada would surprise even many who are quite familiar with the subject. In Montreal, for instance, the electrical developments were second only to those of Niagara. The Lachine Rapids plant, just finished, and the Chambly plant, now in process of construction, were great electrical works which would advance the industries of Montreal in a wonderful way. For instance, a development in which he was personally concerned, was the transformation of the large steam plant of the Hochelaga mill, of the Dominion Cotton Mills Co.—the largest cotton mill in Canada—into an electrical plant. The mills were at present operated by three steam engines, aggregating 1,800 h.p., and these were to be replaced by a plant of 1,500 electrical h.p., the power being conveyed to the mills from the Lachine Company's powerhouse and transformed at the mills, where it would be distributed over the various departments of carding, preparing, spinning, and weaving, by motors connected direct to the line shafts, from which the carding machines, spinning frames, and looms were to be operated. By doing away with much of the present shafting, counter shafting, etc., now used in transmitting power to the different departments, losses ranging from 20 to 60 per cent. could be saved, and the successful issue of this work would result in many other improvements of a like nature in the power plants of the city. But as in ordinary cases water under a low head would not pay, and as power can be developed in a city like Toronto as low as $17 to $19 per h.p. per year from coal, there was no reason why industrial development should not go on steadily here. Steam was a good prime mover, and could always be depended on. He had seldom the privilege of speaking to an audience of people who controlled so much power as this, and he thanked them for the honor done him in being called on in connection with this toast. Mr. McLaughlin, in a short speech, said he had had the pleasure of being at these dinners for several years past, and was happy to be with the engineers once more. He regretted that owing to a slight indisposition the president of his company could not also be with them to-night. In considering their present position, his thoughts went back to the early part of this century, when the lot of the working man and mechanic was so gloomy. From a position which was a sort of slavery the working man had advanced till now, when many a man had more comforts than their masters of half a century ago. He pointed out that the exports of Canada had increased from $57,000,000 in 1886, to $121,000,000 in 1896, the trade returns at the present time showing exports of $3,000,000 more than the imports. He thought Canada was prepared to go the world over in trade and manufactures. After a well-rendered comic song by Bro. Thomas Eversfield, the "Educational Interests"

was proposed, coupled with the names of Prof. Galbraith, of the School of Practical Science, and A. G. Horwood, secretary of the Toronto Technical School. Bro. W. G. Blackgrove sang "Out on the Deep," which elicited a hearty encore. Prof. Galbraith said that as he had for the past ten years responded to this toast at this association's dinners, the honor might now be given into abler hands. In the work of technical education we were apt to overlook its social influence in giving so much attention to the practical side of the question. Once there was a great gulf between the uneducated and the educated man, but now, through technical education, all are being brought to the same level, the theoretical man being at one end, and the practical man at the other. Thus by technical education we are not only gaining knowledge, but drawing men closer together. Messrs. Fax and Grant then sang, to the great delight of the audience, a topical duet, with the refrain "Goodness Gracious," in which the following allusions were made to the association, the verses having been composed during the evening by Mr. Fax:

I've just heard some news which will cause you to say,
O ! good gracious !
The engineers flourish and prosper to-day,
Goodness gracious !
Just ten years ago they were hobble-de-hoys,
And as a society, just a few boys;
Now nothing on earth shakes their equipoise,
Gracious, good-goodness! Goodness gracious!

Since then they've increased, both in numbers and strength,
And spread the land o'er in its width and its length,
To judge from this gathering, as now it appears,
We'll be overrun sure in the next dozen years.
And if they keep on we'll be all engineers.

To be at these gatherings, is always a treat,
A jollier lot very seldom you'll meet,
From President Mooring to Wickens to-day,
And men of their stamp, there is none will gainsay,
They meet to do good, and have come here to stay.

Mr. Horwood, on behalf of the Technical School, said he looked after the business end of the institution, and was not competent to speak of the technical part, but since the establishment of the school he had noticed the effect of technical education, not only on the mechanical classes, but upon the policy of the Government itself. When it was first started it was a matter of doubt whether a system of secondary education was a necessity, but the Minister of Education had modified his views on the subject so far as to introduce a bill to enable High School Boards and County Councils to establish technical branches as an extension of their present system. Technical education had a great future before it, and one way to give the manufacturers of the country supremacy, was to educate the mechanic. Referring to the remarks of Mr. McLaughlin, he thought there was still a good deal of slavery among the working classes, but he believed the development of machinery and inventions would bring about a reduction in the hours of labor to the advantage of both men and manufacturers. "The Executive," was coupled with the name of Bro. E. J. Philip, the executive president, who spoke of the progress of the association. The Canadian association was not as big as that of the United States, but it was making steady headway, and held what it got. He mentioned the conference to be held the following day between representatives of the Ontario Association of Stationary Engineers and the C.A.S.E., for the purpose of revising the draft bill for licensing steam engineers, which was to be submitted to the Dominion Parliament at its next session. The engineers in the chief cities, such as Montreal, Toronto, Hamilton, and Kingston, appeared to take most advantage of the benefits of the association, and in this connection he paid a high compliment to the Hamilton branch, which was now doing the best work in education of any of the local associations. That association had planned a series of open meetings for educational purposes, which was creditable alike to its members and their outside friends, and he hoped to see the example followed elsewhere. Harry Brown then sang "A Hot Time in the Old Town To-night." Bro. Wickens, who was greeted with "He's a Jolly Good Fellow," spoke to the toast of the "C.A.S.E." He felt proud to be called the father of the association. This was the only body in Canada whose members spent their own time and money in educating and improving themselves. The first plank in their platform was the educational one. They were not a labor union, as many outsiders supposed; indeed, they were neither afraid nor ashamed to take the best and smartest manufacturers or employers into the association, and many of these manufacturers had found that they could learn something from the association. He was proud to recall the fact, already alluded to this evening, that eleven years ago the Toronto association had its beginning in his parlor, when about a dozen gathered, while now the C.A.S.E. extends from Montreal to Winnipeg, and he was not exaggerating when he asserted that there was not one of the members within range of his personal knowledge but had benefited by the organization, both in mind and in pocket. The one thing the association required was a Dominion license law. If it was not safe for a marine engineer to carry 15 passengers in a boat to the Island without being qualified by license, it was surely not safe for a stationary engineer to have unlicensed control of a steam plant in a factory with 500 people working over the engine-room. After four attempts had been made in the Ontario Legislature a permissive law was passed authorizing an examining board of the Ontario Association of Stationary Engineers to grant certificates of competency, and under this law 750 certificates had been issued to date, some of the holders being now resident in other provinces, including Manitoba, Nova Scotia, New Brunswick, and Quebec. Another proof of the good work done by the C.A.S.E. was that the Toronto Technical School was the outcome of agitation by the members; it being at their solicitation that the first vote of $2,000 to found the institution was passed. Last year the attendance at the Technical School was 1,500, while the total attendance of the three Collegiate Institutes was only 30 more; while the cost of the latter per pupil was $36.50, against $6.60 per pupil at the Technical School. The Toronto branch of the C.A.S.E. had paid out $400 for lectures, etc., and now have a library and other property worth $600. After a song by Mr. Grant, the "Sister Associations" was proposed, coupled with the names of Robt. Mackie and Robt. C. Pettigrew, of the Hamilton branch. Bro. Mackie said that when any of the Hamilton boys came here they felt as if they belonged to Toronto, as there was always a true brotherhood existing between them. They often had visitors from the Toronto branch coming to Hamilton, and they were always welcome. The educational features were stronger in the Hamilton Association than ever before, and through the efforts of men like Bro. Pettigrew, who was himself a member of the city Board of School Trustees, they were having a series of most instructive meetings this winter. Bro. Pettigrew said he was glad to be present on this occasion to share the hospitalities of Toronto branch, and thanked the association for the honor done him in being called on. The Hamilton branch was not so large as that of Toronto, but it was increasing, both in the interest of the meetings and in membership, some new members having been initiated at the last meeting. The fortnightly open meetings which had been aranged for the winter season, were likely to be productive of much good. They had already had a most instructive lecture from Bro. Philip on "Condensers," and they hoped to have other subjects treated by visitors from Toronto in the future. "The Press" was replied to by E. B. Biggar, of THE CANADIAN ENGINEER, and T. S. Young, of the *Canadian Electrical News*. Bro. Mackie, of Hamilton, proposed the toast of "Toronto No. 1," complimenting President Mooring, who returned thanks, and then proposed the health of the host. Mr. Richardson responded in a well-turned and witty speech, in which he showed that he appreciated the value of factories as an element in the progress of a city like Toronto. As for a big new hotel, which one of the speakers urged, he thought that might safely be deferred until some of the existing hotels were able to pay running expenses. The company broke up with "God Save the Queen," at 1.30 a.m. The dinner committee consisted of Bros. Samuel Thompson, James Huggett, C. Moseley, Thos. Eversfield (chairman), and Geo. Thompson (secretary), who did their work to the general satisfaction.

Toronto, No. 1, C.A.S.E., had the meeting hall destroyed by fire on the night of November 30th. The loss will amount to about $200, being chiefly upon the furniture. We hope the members and their friends will all rally to the aid of the society and once more place the society in possession of models, etc., to take the place of those destroyed.

On Thanksgiving Day a combined meeting of Toronto, No. 1, C.A.S.E., the executive committee of the C.A.S.E., and the Ontario Association of Stationary Engineers was held in Toronto to consider the steps necessary to secure legislation along the lines of the bill brought up at the last session of the Dominion Parliament. It was decided to push the bill in the same form as last year. Circulars are to be sent out to all branches of the C.A.S.E., and to all the members of the Ontario Association, urging them to bring all possible influence to bear on the different members of Parliament to secure the passing of the bill.

The Hamilton branch of this association held an open meeting in the hall, on Tuesday, Nov. 8th, President Wm. Norris in the chair. The meeting was well attended, and very interesting. Instead of having a regular paper read, a number of questions taken from the question-box were answered by some of the members present. President Norris explained the difference between an alternating dynamo and a constant current dynamo. He expected a paper going more thoroughly into the subject would be read later on in the season. He also made a few interesting remarks on the construction and use of magnets. Geo. Macki gave the formula, and explained the method of ascertaining the amount of horse-power to be used by an engine in increasing or decreasing the number of revolutions per minute. He also satisfactorily answered a question on the supporting power of stays. The open meetings in connection with this society here are very interesting and instructive, and are well attended.

HOW TO MEASURE.*

BY W. H. BALLARD.

In measuring anything it must be compared with a standard, the measurement of which is known. Examples of common standards are pounds, yards, etc. Although it is generally the case, it is not necessary that that which we measure is greater than the standard. In measuring a surface or area, we take a small portion of the surface (it may be anything, a square foot, yard, etc.), and compare the extent of the whole surface, which we do not know, with that which we do know. For instance, take a surface 12 ft. square and mark off one square yard in the corner; four of these squares would reach from one side to the other, and form a strip one yard wide, and if this strip is repeated until the whole surface is covered, the measurement of the area will be found by multiplying the number of strips by the number of square yards contained in each. No matter how far extended the surface may be, it is measured by this process. Whatever you start multiplying by, the result must be, if by feet, the result will be in feet, and if by yards the result will be in yards. The same principle is used in measuring any figure, large or small. To take a proportion we have to start with something which we definitely understand. In measuring solids we start with the cubic inch, foot, or yard.

This brings us to the second point. In the first place, it was shown that measurement consists in comparison. Secondly, it consists in comparing with something else of the same kind. If weight is to be measured, it must be compared with a certain definitely understood weight, such as a pound, etc. Value is measured by the dollar; area, by the square foot or yard; volume, by cubic inches, feet, or yards; length, by something which contains a certain known length; if any moving object passes through a certain space in a certain time, it is a measure of velocity. The surface of a cone is measured by multiplying the length of the slant line by half the surface of the base. To find the cubic contents of a cone, first find the area of the base, and go through the process of finding the volume of a cylinder, then divide by three, as a cone equals exactly one-third of the cylinder.

A simple way to find the height of a smokestack is by comparing the length of its shadow and comparing it with the shadow of some object of which we know the length. The Imperial standard of measurement is a bar about 40 or 42 inches long at two points, on which there are two gold plugs, and the difference between these points is the Imperial standard yard. In all measurements of length the yard is the standard. Measurements were originally made by comparing objects with parts of the human body, such as the length of the hand, etc.; and land was measured by the length of the foot-step. The standard of weight is made to depend on the standard of time. All measurements have reference to the three fundamental units—time, weight, and length.

* A paper read before the Hamilton Branch Canadian Association of Stationary Engineers at an open meeting, Nov. 23rd, 1897.

THE GOLDEN NORTH.

It is easy to be brave in the presence of topographical and climatic difficulties on the printed pages, and as easy to overcome them—in fancy. The difficulties of Klondyke travel have already given pause to the crowd of inexperienced persons who rushed to the gold fields without due reflection, and with but little knowledge. Numbers who failed to reach the end of their journey are now the impatient citizens of Juneau, Skagway, Dyea, and St. Michael's, and those who have succeeded in reaching the mines have found that for the present gold is by no means the commodity of greatest value. That the deposits cover a vast area, and are unusually rich, is now established beyond cavil. According to Wm. Ogilvie, the gold-bearing zone extends from Cassiar, or probably Cariboo, following the general trend of the coast line through the head of the Hootalinqua, the Pelly, Stewart, Klondyke, Forty Mile, and across the international boundary to Circle City. The width varies from 10 to 150 miles. If this fact were supported by geological theory only, the great wealth of the recently-discovered placers would reasonably suggest that nearly all the gold was massed in a comparatively small area; but the statement is made on the authority of many actual discoveries of the metal in different places within this zone. Enough is already known of the neighborhood of Dawson City, and Cassiar is regarded almost as a dream of the past; but so recently as the end of October, Charles Law reported new and rich placers in the north-west portions of the Cassiar district, east of Teslin Lake, and the discovery of extremely valuable gold-bearing quartz. The placers themselves have been found to justify all that has been said of them. On Bonanza Creek there are about 100 claims that will certainly yield from $250,000 to $500,000 each, and on the Eldorado there are about 30 claims that will possibly average $1,000,000 each. Mr. Ogilvie expresses his settled conviction that the claims on these two creeks alone will yield close on $70,000,000 before they are exhausted. An old American miner, speaking of the wealth of these creeks to Mr. Ogilvie, said that the diggings in the Circle City district, which were once thought very rich, were merely Chinese diggings compared with them, and were outshone by single claims on the Eldorado. In the neighborhood of these there are many splendid prospects, which have yet to prove their actual value. Goldbottom, Hunker, and Last Chance creeks are known to be of immense value, and three branches of the Indian River—Dominion, Quartz and Silver Creeks, are reported to be second only to the Bonanza and Eldorado.

Hitherto luck has played an important part in the location of claims. It does not by any means follow that a claim next to one of the wealthiest will yield anything remarkable. Mr. Ogilvie tells of two men who had toiled for 42 years in the Yukon, never making more than a living, who came to own No. 24 Eldorado, and on cleaning up $11,000 each, decided to return home and end their days in modest comfort. The very next claim to theirs was owned by a young man who went in last summer, and who has already extracted more than the two old men own between them. Many of the now famous placers had been prospected before their real value became known. The Klondyke itself was run over in 1837, and again in 1893, but the wealth of its creeks remained hidden until 1896, when three men, named Henderson, Swanson, and Munson, announced their most extraordinary find, and thousands of persons last year walked over the neighborhood of Skookum Gulch, ignorant of the fact that under the moss lay a deposit of coarse gold, from which a miner could take in a day as much as a skilled mechanic could earn by a year's labor in a large city.

In the majority of cases, however, mining entails very hard work, and it must be remembered that the methods of prospecting for placers and lodes usually adopted are often inapplicable in the Yukon. The deposits of gold are usually covered with silt, to a depth of from eight to twenty feet, which was deposited on the top of the gold-bearing layer after the stream had ceased, as a rushing torrent, to tear the exposed metal from its rocky bed; and the discovery of such placers will entail a vast amount of patient labor. It is sometimes necessary to dig twenty, and even thirty holes, at about the rate of a foot a day, before pay dirt is struck. Mr. Ogilvie mentions a case in which a man had dug eleven holes without finding anything. Notwithstanding this, some others retained their confindence in the claim, and paid $2,500 for a half interest in it.

The discovery of Cone Hill, which seemed to be one extensive block of rich quartz, is already known to our readers, but we may add that it produces from $5 to $7 a ton, and there are six other quartz claims in the neighborhood of Forty Mile and Dawson. A Montana expert miner has located two claims about 40 miles up the river, which produce from $3 to $11 per ton, and on Bear Creek is another, which Mr. Ogilvie rates as one of the best properties in the country, while on Gold Bottom Creek there is a claim from which specimens treated merely by a hand mortar, produce from $100 to $1,000 to the ton. Quartz has been reported in other places by Dr. Dawson and the mother lode remains to be discovered. Bitter disappointment or bewildering success may await the discoverer; but enough is already known to make it certain that quartz mining will become an industry directly the facilities for transportation are increased.

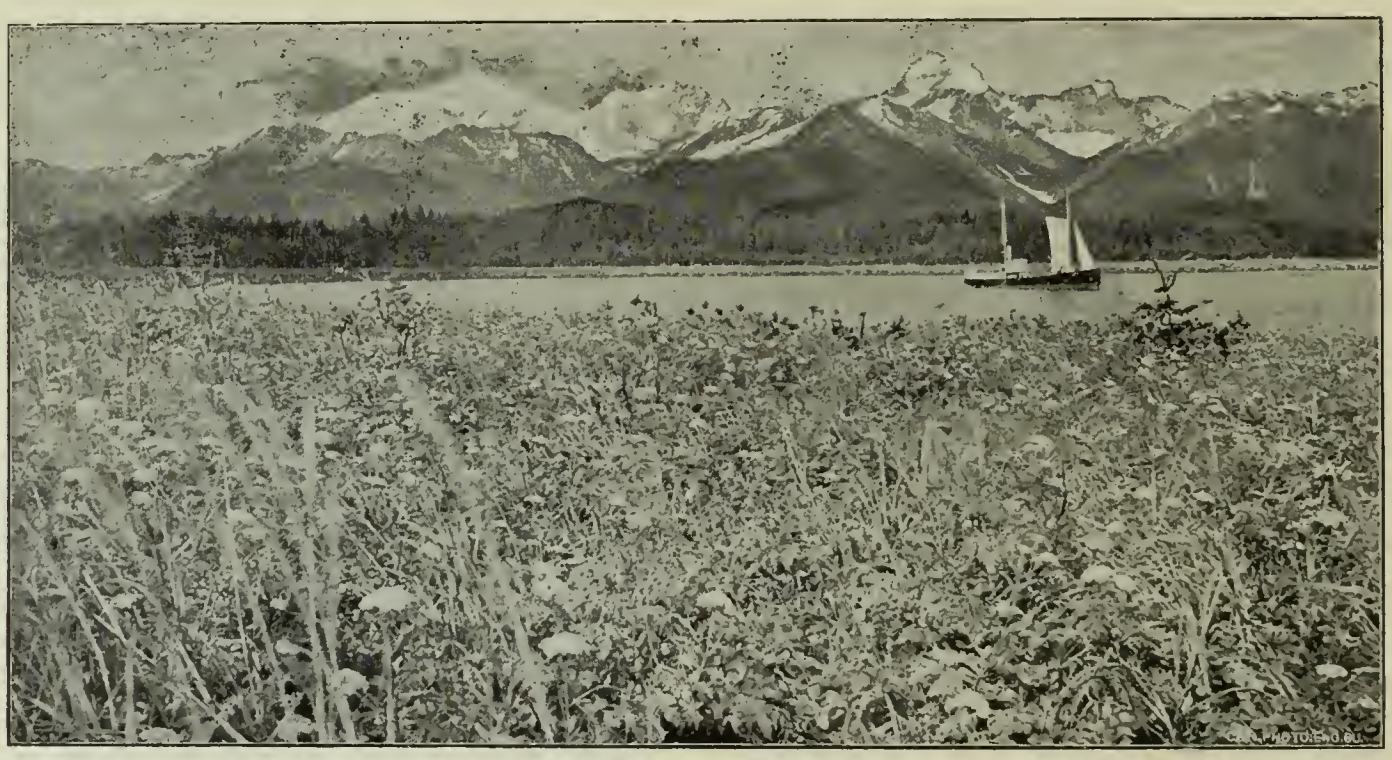
The Minister of the Interior was so impressed with the need of this during his recent visit to the confines of the Yukon district, that he took the earliest opportunity on his return to give public assurance of the purpose of the Government to make the most complete arrangements possible. All the routes have now been traversed by Government agents, and we may expect soon to hear of some permanent plan for the easiest and cheapest transport, not only of gold, but of all the wealth of the Yukon, through Canadian territory. There are proposals for railways, tramways, cable ways, or wagon roads, along every known route to the neighborhood of the mines—from the coast, or from the central portions of British Columbia and Alberta. Steamers are to ply the Mackenzie and Porcupine, the Yukon and the Stickeen, wagon roads and railways are to connect the C.P R. and the head waters of the Pelly and the Hootalinqua, and cableways and tramways are already in course of construction over the passes.

The route which seems to recommend itself to the Canadian Government is that by the Stickeen River. In this case the steamboats, which leave Victoria every few days, will carry you through the Seymour Narrows to Port Simpson, the most northerly Canadian port on the Pacific, and thence to Fort Wrangell. From here you ascend the Stickeen River to Telegraph Creek. There a portage of 150 miles to the head of Teslin Lake is necessary. This portage runs through an undulating and fairly well wooded country, where natural hay might be found for a limited number of horses, and has recently been surveyed, with the object of constructing a railway from Telegraph Creek to Teslin Lake. On arrival at the head of the lake, lumber is cut from the trees in the neighborhood, for making the boats which must transport you down the lake, a distance of 80 miles, and thence down the Hootalinqua to its junction with the Lewes, a further distance of 125 miles; and then on down the Lewes to the Pelly or Yukon. The distance from Victoria to Dawson City by this route is approximately 1,600 miles.

It should be remembered that Hudson Bay traders have been in the habit of entering the Yukon district from British Columbia, entirely over land, for years. Many travelers have recently chosen this route, and one of the police parties was sent that way, with instructions to report upon it. A company has been incorporated under a British Columbia charter, which proposes to build a toll road from Edmonton to St. John, on the Peace River, thence to Lake Teshudy, then across country to the Liard. and then along the Frances to the head waters of the Pelly. J. B. Powell, the promoter of this company, asserts that passengers will reach the Pelly River two weeks after leaving Edmonton.

SHIP V. BARGE CANALS.

The reconstruction of the map of North America, so that the products of the northern part of the United States might find their way to the Atlantic seaboard without passing through the territory of a foreign power, is a problem which has been much dwelt upon by the numerous statesmen of the United States for many years past. Failing to annex the St. Lawrence route, engineers have been called upon to construct one. In a former issue of THE CANADIAN ENGINEER we discussed the different routes by which it was considered possible to build a waterway from Lake Erie to the Hudson River. Of the three leading ones discussed, the engineer instructed by the United States Government to make a report on the subject, Major T. Symons, goes into the merits of that by way of Oswego alone. In this scheme a new canal would be constructed from Lake Erie to Lake Ontario, and from Oswego on Lake Ontario, to the Hudson River. Major Symons, however, only discusses this plan in order to show how impracticable it is. The lowest estimate of cost which he considers at all is $200,000,000, and annual cost of maintenance he believes would be at least $2,000,000. In this rough estimate of the cost little account is taken of the fact that the Mohawk Valley would be flooded, and enormous damages result to the New York Central Railway and other powerful corporations. The expenditure on impounding works for the storage of water in the Adirondacks would also amount to a vast sum.



LITUYA BAY, LOOKING N. N.-E. MT. FAIRWEATHER TO THE LEFT, AND MT. LITUYA TO THE RIGHT.

The whole project may therefore be dismissed from the public mind as being something which is too expensive for even the people of the United States.

In laying aside the proposed ship canal, however, Major Symons urges strongly the enlargement of the present Erie Canal, so as to give passage for barges 200 feet long, 30 feet broad, and drawing 10 feet of water; that the locks be reduced in number, and arranged to give passage to two boats at one lock, with mechanical lifts to replace flights of locks where advisable; the business to be conducted by fleets consisting of one steam barge and three motorless consorts, running between Buffalo and New York: the barges to be strong enough for running on the Great Lakes. Major Symons claims that if a ship canal were built the business would not be done in large lake or ocean vessels, but in barges and boats which could be equally well accommodated in a canal of less size. He furnishes a vast number of statistics and a great many tables in

support of the above propositions. We have only room for reference to the following: Estimated cost, Chicago to New York, including lake freight, 1.37 cents per bushel, transfer charges 2-3 of a cent per bushel, and 10 per cent. profit on cost of transportation between Buffalo and New York:

	Cents.
By ship canal, in 5,000-ton vessels, per bushel	4.46
By 1,500-ton barge canal, with semi-independent motive power and consorts, per bushel	3.05

If what Major Symons claims is true, the present outlay on the St. Lawrence canals is not a necessity; but if barge canals are all that the traffic requires, why is the St. Lawrence route at present comparatively deserted, the Ottawa canals hardly ever in use, and the locks of the Rideau system rotting in idleness?

THE CHAMBLY POWER PLANT.*

Four important long-distance transmission plants using water power as the prime mover have recently attracted much attention. While two of these plants, Chambly and Mechanicsville, are quite alike in their salient features, they are widely different from the other two at Bakersfield, Cal., and Three Rivers, Que., and among them is represented a wide variety of engineering. There can be no doubt that the application of water power for electrical generation and transmission is a rapidly developing art, and that in many places in the country hitherto unproductive streams may now be turned to good account by means of electrical transmission of power. Taking all these plants together, perhaps the most striking feature to electricians of the older class is the enormous potentials which they employ, and the extreme simplicity of the means by which these are controlled and handled. It apparently needed the example of the Niagara installation to induce the investment of large capital in enterprises of this character. Despite its glaring defects of engineering the Niagara plant still stands foremost as a representative installation, and its unquestioned success has been the means of widely encouraging the establishment of similar plants. It is pleasant to be able to entirely commend the work that has been done on some of the new installations. Perhaps it is fair to say that, in many respects, the plant at Chambly is one of the most carefully planned and best designed that has yet been constructed. While many engineers will feel at first some doubts about the propriety of running dynamos below the water level of the forebay, it seems that it should be easily possible to guard against anything short of an absolute overflow of water over the crest of the dam at a point above the dynamos. With any reasonable variety of hydraulic engineering this casualty could be placed in the category of visitations of Providence, since it is possible to guard against every conceivable variety of accident which would make such an overflow possible. Dampness is no longer such an enemy to insulation as it was in the older days, but it would have been

TWO STEP DAM FROM BELOW, SHOWING TAIL RACES AND FLUMES.

perhaps equally easy to use a type of wheels with vertical shafts and put the dynamos high and dry above the water level.

*Reprinted from the *Electrical World*, New York.

Whatever may be said about the electrical features of these installations it cannot be denied that the hydraulic engineering at Chambly is of the very highest class. It seems that the means adopted must secure the highest possible efficiency, and it would be difficult to conceive of more beautifully simple and direct mechanism than that employed. The only feature of their work about which the hydraulic engineers may feel any doubts is the method of governing employed. The physical difficulties in the way of governing water wheels are very great, and this is especially true in turbines in which a large volume

FLUMES AND DRAFT TUBES BEFORE TURBINES WERE SET.

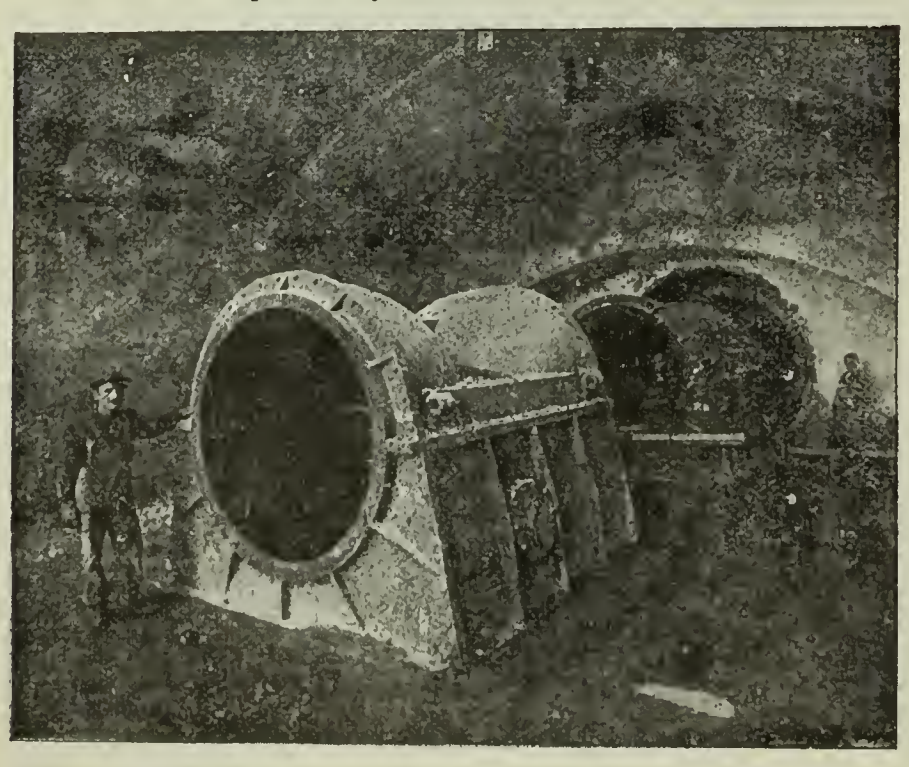
of water in motion, possessing enormous inertia, has to be handled through the agency of gates, themselves necessarily heavy and difficult to move. There seems to be no escape from this particular feature of water-power work, and the engineers who have designed the governors in use at present are to be congratulated upon having accomplished such excellent results under such difficult conditions. The simultaneous construction in this country of half a dozen or more plants of the largest size and highest class for long-distance power transmission can be regarded as very gratifying evidence of the success which has marked previous installations. It also points to the not distant day when any water power, of any considerable size, within transmission range of a centre of population, will be utilized in this way. What this means to the citizens of towns the greater part of whose power is brought in in this way is hard to realize at first. It is possible that successful long-distance transmission of power of this kind may result in smokeless cities, as it certainly will result in the cheapening of power and its small sub-division and application to many uses to which it is not now applied. In this way, as notably heretofore in the case of the electric light and the electric street railway, electrical engineering has had a direct influence upon the social environment for the greatest good.

In a recent number of the London *Electrician* a list of some large installations in America in erection and under contemplation is given, and the question asked: "What will we do with it all?" referring, of course, to the vast powers. It may be proper here to say that there is no country in the world which can absorb so much power or find so many uses for it as this. The development of a great power at any point produces an industrial condition which shortly results in the establishment there of works which find it to their benefit to seek cheaper power or different conditions. In this way there has grown up around Niagara Falls a great manufacturing city, which is rapidly extending. It is by no means visionary to hope for the establishment of similar great centres of industry within the working radius of electrical transmission from other such sources of power. The actual powers used in industries in the United States are probably much in excess of the total of all the available water power in the country, and the question asked by our contemporary seems to answer itself when this fact is considered.

Canada is a region of gigantic water powers, which have waited for the advent of electricity to be utilized for the many purposes to which they are applicable. Perhaps the finest installation for the development and transmission of the power

of falling water extant is that of the Chambly Manufacturing Company, at Richelieu village, Quebec. At this point, about 25 miles distant from Montreal, the Richelieu River falls through a long series of rapids. From early days a wooden dam between Richelieu village on the one side of the river and Chambly on the other has been in existence, supplying power to a few small mills. The new structure which takes its place is one of the finest examples of hydraulic engineering on the continent, consisting of a massive concrete dam, in which, as an integral part, is built the power-house, with a capacity of 20,000 horse-power.

This dam is about 2,000 feet long, 6 feet wide at the crest, and constructed of a concrete composed of the broken rock of the river bed, mortared with sand from the vicinity and American cement. The back is vertical throughout, and the apron is curved so that the overflow water is discharged horizontally, obviating any destructive washing action at the base. A liberal use of one-half inch iron rods, incorporated with the mass of the concrete, gives great strength to the structure, and a surface dressing of neat cement insures the greatest impermeability. This is said to be not only the most carefully constructed but also the largest concrete dam on the continent. The dam consists of three portions, two of which run perdendicularly across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam, and near the right bank of the river, is built the power-house. Here the dam consists of two levels, or steps, over which is built a structure of steel beams and brick walls, 308 by 51 feet, for the protection of the machinery. The upper level, which is about 2 feet above the surface of the water in the lake, formed by the dam, will contain the switchboards and controlling devices and such offices as are necessary. In this part of the dam eight rooms, or flumes, each about 20 feet square and 10 feet high, are constructed, their arched openings being under the water level, for the reception of the wheels. These, of the horizontal-shaft pattern, number four in each flume, each wheel being 46 inches in diameter. These wheels are mounted tandem on one shaft in two pairs, between the wheels of each pair being a large cast-iron box communicating with the draft tubes, which extend through the solid concrete of the lower step of the dam to a point below the level of the tail water. The draft tubes are built of sheet steel, and are 9½ feet in diameter where they leave the boxes, and 10 feet at their outlet. The upper extremities of these being one behind the other, in the line of the shaft, necessitated their construction in a curious skew curve. This installation seems to run to superlatives, since these draft tubes are the largest ever constructed. Their bedding in concrete excludes all possibility of leakage, and it is confidently



CASINGS FOR FOUR TURBINES IN PLACE IN FLUME.

expected that the full advantages of the head of 28 feet will be realized by their use, although the wheels are but a few feet below the level of the intake water. Under this head, and at the speeed of 153 r.p.m., each wheel will develop 660 horse-power, or a total of 2,640 horse-power to each shaft and flume.

The governing of the wheels will be by means of Giessler electro-mechanical governors. These are relay governors, the revolving balls actuating a small lever which closes electrical contact at speeds higher or lower than that for which the instrument is set. These contacts control electromagnets which operate clutches on the main shaft geared to the gate of each gang of wheels. It has proven an excellent and reliable governor in other large hydraulic installations.

At present only four of the eight sets of wheels are being installed, together with two 28-inch wheels, giving 750 horse-

BUILDING THE UPPER STEP OF POWER-HOUSE DAM, SHOWING MANHOLE TO FLUME AND ENTRANCES TO CABLEWAYS

power for driving the exciters of the large dynamos. The whole of the hydraulic machinery was furnished by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, and reflects much credit upon that concern by the solidity of its construction and the great accuracy with which the parts of the heavy wheels and draft tubes were assembled at Chambly by its constructing engineer, H. A. Wright.

The shaft of each gang of turbines passes out horizontally through a circular steel bearing plate on the down-stream vertical face of the upper step of the dam, and is directly connected to a 2,000-kw. generator, giving two-phase current at 60 cycles per second and 12,000 volts. These machines are of the inductor type, having no moving wire. The inductor is about 10 feet in diameter, and of very massive construction. The single-circular field coil is wound on a brass spool of about 10 inches face by an equal depth, and completely surrounding the inductor. The armature is in two parts. The insulation of these armatures is necessarily most massive and substantial. All the dynamo machinery is now under construction by the Royal Electric Company, Montreal, from designs by the Stanley Electric Manufacturing Company, Pittsfield, Mass.

In the space above the flumes in the upper portion of the powerhouse dam a large conduit has been made for the reception of the leads from the dynamos to the switchboard. Lead-covered, rubber-insulated cable will be used for these. In the walls of the power-house a number of large terra-cotta pipes, about 3 feet long, bent to a quarter circle, with the convexity upwards, have been built in, and through these the cables leading to the pole line will pass out without touching anything between the insulators inside and outside the building. Two pole lines will be constructed to Montreal, either one being sufficient to carry the load. This construction was adopted to minimize the chances of accidental breakdown, and to make repairs easily possible without danger to workmen. The poles are of chestnut, none being less than 40 feet long. Each pole carries two cross arms, the usual "square" for two-phase transmission being observed. The insulators are of a deeply petticoated porcelain type, somewhat similar to the Niagara pattern, but lacking the grooves for conducting away rain water. They are mounted on oak pins, having a steel rod in the centre of each. A line of barbed wire is run along the tips of the poles, and four similar lines are attached to the ends of the cross arms, all five being connected together and grounded by means of 8 feet of iron gas pipe at each pole. The line wire is bare, of 00 gauge, and is tied to the insulators by two pieces of No. 12 gauge soft copper wire. A short distance below the main line a short cross arm carries the two No. 12 copper wires of a telephone circuit. The main power trans-

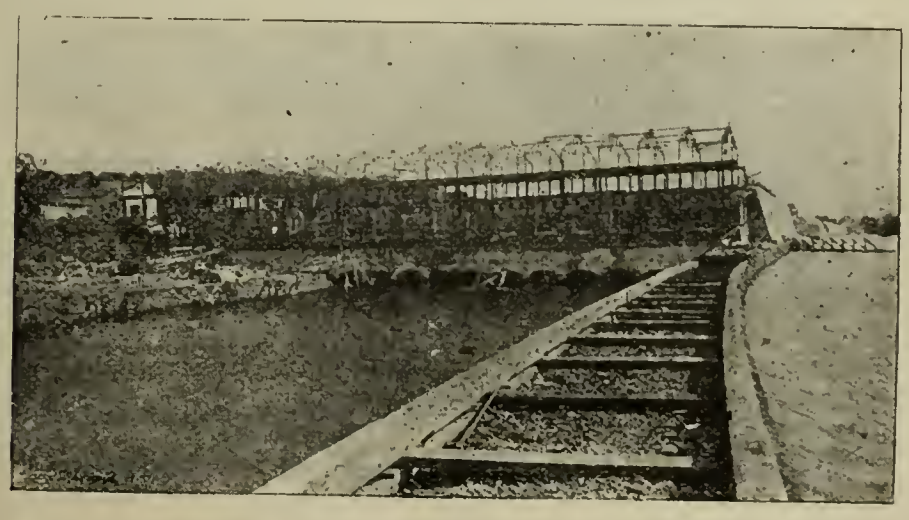
mission line will end in the electric-light station of the Royal Electric Company, at Montreal, where 6,000 horse-power will be used for incandescent and arc lighting and direct-current motor service. The large two-phase generators now employed in that plant for incandescent lighting and power will be rewound as synchronous motors, and connected directly in the 12-000-volt circuit. These machines will then be belted by a system of countershafts to the arc light generators and other continuous-current machines of the station, to which they will furnish power. A group of static transformers of 150 kilowatts each will be aranged in the basement of the present station, reducing the line voltage of 12,000 for distribution over the present circuits at 1,000 and 2,000 volts, two-phase.

These transformers are now under construction at the works of the Royal Electric Company, Montreal. Their

UPPER SIDE OF DAM SHOWING WASTE GALES.

greatest feature of novelty is in the method of cooling employed. The transformer is set up in an iron case in the usual way, this being filled with oil for insulation, and the whole surrounded by a sheet-iron water jacket. As the plant in Montreal is some feet below the level of the Lachine Canal, from which water is obtained under a small gravity head, the water going to the condensers will be allowed to circulate around these transformers in the jackets, and it is expected that this arrangement will result in very effectual cooling.

The troubles with ice, which have been for so long a bugbear to many Canadian plants, are not expected to be at all serious at Chambly. The back water from the great dam will make a lake of still water at least 1½ miles long up the river, and, as this will freeze over the surface at the beginning of the season, no trouble whatever is expected from anchor ice. It is expected that floating ice in the spring thaws will clear the dam without trouble. It is a peculiarity of the Richelieu River, which is the outlet to Lake Champlain, that its current



DAM SHOWING POWER-HOUSE.

is comparatively steady throughout the year, and consequently no difficulties with freshets or low water are anticipated. The construction of the dam and other elements of the power development reflect great credit upon the engineer of the Chambly Manufacturing Company, J. G. Mecklin. The work is progressing at an extremely rapid rate, and the contracts call for the installation of all the hydraulic machinery and the completion of the dam by January 1 next. One of the dynamos is finished and the others are well under way, so it is likely that current will be turned on from this installation on time.

It is expected to deliver nearly 20,000 electrical horse-power from this plant in Montreal, when the total equipment is installed at Chambly.

APPLICATION OF ELECTRICITY TO STEAM RAILROADS.*

BY N. H. HEFT.

The New York, New Haven and Hartford Railroad Company owns and controls about 2,800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third rail system, and 14 miles on the overhead trolley system.

About three years ago, the New Haven Company found that various electric railways in its territory were gradually extending their operations into the field of interurban work, and that the company's passenger earnings were suffering accordingly. It was at once seen that by no ordinary methods of changing schedules or increasing speeds could this lost traffic be won back again, and, with characteristic knowledge and courage, President Clark and the New Haven directors determined to "steal the thunder" of its new competitors and commenced a series of elaborate experiments in heavy electric railroading. It must be confessed that this decision was reached only after some misgivings. To the average railroad man, street railways have, until recently, seemed a pretty sort of toy, fit for apprentices in the art of transportation. Latterly, however, he has waked up to the fact that "the tail will wag the dog" unless some radical action is taken, particularly in suburban and short distance work, and, in the Eastern sections of the country anyway, railroad men have become modest enough to be willing to look with respect upon the great work which has been accomplished in street railroading.

The first line to be equipped by the New Haven Company was a purely summer road, operated for about four months in the year only, through a narrow peninsula running out from the main land on the Massachusetts Coast from Nantasket Junction to Pemberton, a distance of about seven miles of double track. This line was chosen partly because the main line operation would not be interfered with in case of trouble with the electric trains, and partly because of the existing heavy summer traffic which would put the new apparatus and the feasibility of the entire system to a severe test. An overhead trolley line was built, with centre pole construction, and everything made very strong and more substantial than was at that time found in any street railway work to our knowledge. At the time of construction of this overhead line, there were no suitable movable switches in the market, and we had to remodel and have built especially for our purpose those which we finally adopted. One feature, perhaps, worthy of note, is the connection of the overhead switch with the track switch in such a way that both are controlled by a single lever at the switch stand.

The line was operated for the first summer with excellent success, and, all fear of trouble having disappeared, an extension of 3.6 miles was made on the main line of the company's Plymouth division, from Nantasket Junction to East Weymouth, this section being operated by the third rail system. In December, 1896 we commenced work on a new line running from Berlin, Conn., through New Britain to Hartford, a distance of 12.3 miles, three miles of which, from Berlin to New Britain, is a double track, and the remainder, from New Britain to Hartford, a single track. A power station was built at Berlin at one end of this line, partly because of a desire to test transmission of power to a considerable distance, and partly because Berlin is the centre of several radiating lines, which may eventually be put in operation by electricity.

We have learned very thoroughly, in our street railway experience, the lesson of the importance to any transportation agency, working in a thickly populated territory, of uniform fares, and a frequent and regular train service—of a train service which requires no printed schedule to enable people to know when cars may be found in waiting. The time has come when every progressive railroad manager must recognize that new conditions and the new character of competition require a complete change of operating methods.

On its Nantasket Beach line, the New Haven Company gave, during the last summer, a regular half hour service from 6.30 in the morning until 11 30 at night. The fares charged on the Nantasket Beach line before the advent of electricity were ten cents from Pemberton to Nantasket and eighteen cents from Nantasket to East Weymouth, a total of twenty-eight cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of five cents from Pemberton to Nantasket and five cents from Nantasket to East Weymouth. Under these new conditions the traffic has increased enormously on this line, the summer of 1895, the first of electrical operation, showing an increase of 92.6 per cent. over the previous summer in the number of passengers carried, the summer of 1896 showing 45.1 per cent. increase over 1895, while in the summer just passed, we have carried nearly three times as many passengers as

*Condensed from a paper read before the American Street Railway Association; Niagara Falls, N.Y., October, 1897.

in the last year of steam operation. The operation of the line from New Britain to Hartford was commenced in May last, with a regular half hour train schedule from 6.00 in the morning to 11.30 at night. and with a uniform fare of ten cents each way, instead of twenty-three cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way stations being carried by the regular steam trains running on a parallel track. Sixteen trains each way per day are run, connecting with steam trains. Under the conditions named on the Hartford-New Britain line we have carried, during the three summer months, 400 per cent. more passengers than we carried through the corresponding months of last year.

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach this summer. There are several grades and a great many curves on the line. There are no excessively sharp curvatures or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than seventeen stations on a line only 10.6 miles in length, or an average distance between stations of about six-tenths of a mile. To make a run of 10 miles with sixteen stops in twenty-six minutes: to be obliged to do this in order to connect with boats arriving at regular half hour intervals—are things which cannot possibly be accomplished by steam locomotives. The reason is found in the tremendous accelerating power of properly designed electric motors with rotary motion, as compared with reciprocal motion of steam locomotives. On this line, for example, a 60-ton train in running from Windermere to Allerton, a distance of only 1,800 feet, reaches a maximum speed of 31 miles per hour, while in the longer run from power station to Nantasket Junction, a distance still of but 5,808 feet, a maximum speed of 39 miles is reached. The entire distance is covered, in regular service, at an average speed of 24.6 miles per hour, including stops. Between Hartford and New Britain, the 9 3 miles distance is covered regularly by motor cars with two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor, a maximum speed of over 60 miles has been made; the entire distance of 9 3 miles being covered in 10 minutes. On this line, between Hartford and New Britain, a 52-ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at twenty-nine grade crossings when single car trains are run.

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart far from the long-established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines. This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the much greater pleasure in riding. With electric operation, open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line, we have used heavy open cars with great success.

The motor car which we have so far used we do not consider, by any means, the final type, and even now, we have in mind plans o combination cars which we believe will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains sixteen cross seats, capable of seating ninety-six passengers, and the entrance is from either side with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125-h.p. motors. The total weight of the motor car is 32 tons, and the trailer car of the same type weighs 25 tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 324 miles each day, without apparent injury. We found the motors we are using already on the market when we commenced our experiments, and until recently no attempt has been made by us to specify changes. Under these circumstances, great credit is due the manufacturers for their efforts to meet the difficulties encountered. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfill to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed towards completely encasing the motors, so as to make them waterproof, but in doing this, ventilation has been sacrificed. We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose pipe connected to our air brake reservoir, but this is, at best, but a makeshift. It is very difficult to dispose of all the necessary cables, wires, brake rods and chains, air brake cylinders and apparatus, switches and other car-controlling mechanism in the limited space beneath the car floor, as may be readily imagined by those familiar with street railway work. As a consequence, there has always been more or less controversy between those responsible for the placing of the different portions of the equipment, as to who shall have the first right to a given space, perhaps hardly half a dozen square inches in section. There is also more or less trouble with abraded wires, short circuited shoe hangers, etc., and for our future work, we are making an effort to simplify this mass of equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor, several inches below, specially provided for the purpose,

For operating heavy trains of this character, where currents of from 500 to 1,000 amps. are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing. We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected. The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length. The problem of braking, which is so important a one in street railroading, is found more so with us, since the train weights and speed are enormously greater. The regular Westinghouse air brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors, we have an electric motor compressor controlled by an automatic regulator, which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. We find it quite impossible to prevent the destruction of trolley wheels by almost continual arcing when attempting to take from the wire the heavy current required in starting and during acceleration, as well as the smaller currents taken at the maximum speed. There has been a good deal of trouble, moreover, in keeping the trolley on the wire in making speed and taking curves, and many trolley poles have been broken. The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large.

These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes which take the current from the rail to the motor circuit have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings when these blocks happen to be slightly misplaced, so that the shoes strike them at the wrong angle. The contact shoes are suspended by cast iron links, which are intended to be weak enough to allow the shoe to break away easily without doing damage to the framework of the car. The trail cars are also equipped with shoes, and connected with the circuits on the motor car by means of flexible couplings, and it is possible, therefore, when the cars are run in train, to bridge the longest gaps found at grade crossings and switches, so that it is not necessary to turn the current off on approaching these. This arrangement makes our trail cars independent of the motor car for heating and lighting.

Our third rail and return circuit experience will be of value, as we have made a wide departure from established methods. First is the question of insulation. The third rail has a potential of 600 volts above the ground, and rests upon creosoted wooden blocks doweled into the ties, its eaves being only 1⅝ inches above the tie. Now it frequently happens that water accumulates two inches or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short-circuited between the third and service rails through the water, the distance being about two feet each way. Nevertheless, we have been able to operate our road without the slightest difficulty when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter, been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places, 10 miles apart, during a heavy rain storm, and we have found that the leakage was almost imperceptible when both cars on the line were at rest and their air pumps out of circuit. At the same time the wattmeter was standing still. Of course, if a long length of track was submerged, the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result. We aim to so connect our third rail lines and the service rail return, as to have a practically complete metallic circuit of extremely low resistance, as far as possible disconnected with the ground. We do not believe in grounding our track, and, though ground plates are placed at the

station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, sixteen bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests. The service rails are bonded with the greatest care, four copper leaf bonds, having a cross section of copper equal in conductivity to that of the rail, being used. These bonds are inserted in the base of the rail instead of the web, so as to prevent breakage through play at the joints. The copper leaves are cast into end piece blocks in such a way as to weld them thoroughly together in the blocks. The latter are formed into a hollow cylinder, 1 inch in diameter, which passes through a hole in the flange, and by which a large area of contact is secured. Tapered pins are driven into the inside of this cylinder from the top of the flange, and the connection made is very perfect. The form of this service rail bond is shown in Fig. 5. Careful tests have shown that the joints of both third and service rails have now a slightly greater conductivity than an equal length of the rails themselves. Some of the tests of our third-rail and service rail bonding and of the experiments which have led up to our present practice may be of interest, and are given below.

A few words about the danger of the third rail system would be, perhaps in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and anyone can step upon it from a dry tie without the slightest effect. On all except wet days, our employees work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horse play. On wet days, they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employees have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system. As a result of exceptional care which we have taken in bonding our third and service rails, we have found it unnecessary, in any third rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12.3 miles, straight away from the power station. This work is made up as follows: From Berlin to New Britain, a distance of three miles, there is a complete double track electric road with two 100-lb. third rails, and four 74-lb. service rails, all most carefully bonded as described above. From New Britain to Hartford, a distance of 9 3 miles, there is one complete electric track, with 100-lb. third rail and 70-lb service rails, all carefully bonded, in addition to which we have connected to the service rails of the electric track the rails of the second track, paralleling this the entire distance, at various places, in order to get the benefit of whatever conducting power there might be in this track connected only by its fish plates at the joints. As a result of this work, we are able to run two trains of 52 tons each on the New Britain and Hartford line, with an average loss of but 26½ per cent. The current output of the station at such a time averages about 300 amps., with a maximum flow of about 700 amps., at a pressure of 600 volts. Of course, if the service were heavier, so that more cars would be required, it would, undoubtedly, be necessary to reinforce the third rail with feeders. The method of bonding the third rail has already been described and illustrated in previous numbers of THE CANADIAN ENGINEER.

In our Nantasket Beach station we have installed two engine generator units of 800 h.p. and 550 k.w. capacity each. The steam is supplied by eight boilers of 200 h.p. rated capacity each. On heavy days both these engines are required, but on ordinary days but one only, and this is not fully loaded; the average loads being, perhaps, one-half the maximum. In the Berlin station we have installed two engine generators of 1,200 h.p. and 850 k.w. each. The steam is supplied by ten horizontal tubular boilers, of 200 h.p. each. One unit only is required in the practical operation of all the cars on the Berlin and Hartford lines, and the average power output is hardly one-fourth of the maximum capacity. In both stations our aim has been not to follow out any engineering fads, but to provide apparatus proved by long experience to be of the most simple and durable character. The details of piping and arrangement of steam apparatus have been so thoroughly described in the technical papers that it is unnecessary to refer to them here. We are now running our Nantasket plant condensing and our Berlin plant non-condensing, the loads in the latter being too light to make condensing profitable. In spite of the fact that these general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half-consumed coal dumped from the extension front of locomotives at the company's various round houses Nevertheless, there is a great deal of steam generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of seventy cents per ton delivered. In order to burn these sparks, we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draft, as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases, which increase greatly and facilitate the combustion of half-burned coal and add enormously to the furnace heat. We originally supposed that some form of shaking or self-cleaning grate would be necessary in burning sparks, but have found in practice that, with ordinary grates, together with the steam blower, there is no difficulty. In our experimental days it was thought that it might be necessary to use a proportion of ordinary soft coal with the sparks, and did so for a while, but it was not long before our firemen were educated to burn sparks only with entire ease, and no other kind of fuel is now used by us. Of course, we have to use a greater weight of this half-consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us in Connecticut about $3 per ton delivered at power station.

A few figures as to the cost of power at Stamford may be of interest. This station furnishes current for our street railway system at Stamford and for lighting our railroad stations with 350 incandescent lamps. We are operating one engine only, of 500 h.p. total capacity, direct connected to one 300 k.w. generator. In the boiler room are six 200 h.p. boilers. For the first six months of full operation with sparks only, the total cost of fuel for this station amounted to three mills per horse power hour, or four mills per kilowatt hour. For so small a station, and one where the average amount of power developed is hardly more than one-third the rated capacity of the engine, I believe this to be a low figure. We have recently made, for our own information, for use in larger plants, special tests of the cost of power developed in this way, using for this purpose a water rheostat, in order to load the engine up to more nearly its full capacity. As a result of these tests, we find the cost of fuel for power, with the use of coal, to be 3.2 mills per horse power hour, or 4.2 mills per kilowatt hour. With the use of sparks, the cost is reduced to 1.9 mills per horse-power hour, or 2.5 mills per kilowatt hour. At our Nantasket power station this season the cost of fuel, with the use of coal, has averaged 4.2 mills per horse-power hour, or 5.6 mills per kilowatt hour, while, with the use of sparks, the cost has been 2.1 mills per horse-power hour or 2 8 per kilowatt hour. As before stated, our Berlin plant has not been run as economically thus far as it will be when a greater load is put on the engines, and it will seem to be in the interest of economy to run compound condensing. At this station, the cost of fuel, with the use of coal, has been nine mills per horse-power hour, or 12 mills per kilowatt hour. Using sparks as fuel has reduced this cost to three mills per horse-power, or four mills per kilowatt hour. It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton-mile hauled, but even here the results would be of little value on account of the wide difference in conditions, and, as a matter of fact, we have never attempted to make such comparisons.

BOILER INCRUSTATION.

When natural waters containing dissolved and suspended foreign impurities are fed to steam boilers for the purpose of generating steam, the fixed and non-volatile nature of these matters insures their remaining behind in the boiler, where subjected to high temperature of heat they finally become baked and firmly attached to the tubes and shell, forming boiler scale, which prevents the water from coming in contact with the iron and by resisting and obstructing the passage of the heat to the water, not only occasions a great loss of fuel, but imperils the boiler to burning, blistering and bagging, and threatens explosions. It is of obvious importance, that the purest feed-waters obtainable should always be selected; but water is seldom found entirely pure.

Steam users who are troubled with scale in their boilers should always consult with some reputable and responsible chemist who has made this subject his special study. His success depends, not only upon a knowledge of water chemistry, but in a great degree must also depend upon a thorough knowledge of practical boiler operation, and the peculiarities and special features of every design of steam boiler met with on the market, therefore, it will readily be admitted, that much discrimination should be shown in selecting any particular chemist to meet this requirement. Many engineers resort to the plan of removing boiler scale by the use of the pick, hammer and chisel, but this is a temporary relief, and does much to weaken the iron. The skin formed on iron during its process of manufacture, is its strongest part, and affords the metal its best protection against oxidation and corrosion.

Some engineers, owing to the parsimony of their employers, use their own chemical formulas to prevent scale in their boilers, rather than undergo the arduous task of cleaning their boilers by hand. This practice cannot be too strongly condemned, as the steam boiler is a very poor place to start up an experimental chemical laboratory, besides, these engineers will seldom meet with success, as their knowledge of chemistry is too limited, while often they are ignorant as to the character of their feed water and the nature of its impurities which form scale in their boilers.

Distilled mineral oils have of late years been much used for this purpose. Aside from the danger incident to the presence of these inflammable oils in manufacturing establishments, from risk of fire, the makers of Lord's Boiler Compounds claim, these oils promote leakage of the boiler parts, the burning and crystallization of the material and overheating of the plates. Some engineers claim that when oil is intelligently used these evil effects can be obviated. These oils are very penetrating, as is seen in their removal of rust from tools, and in penetrating the boiler joints, they so lubricate these parts that the forces of expansion and contraction easily cause them to leak badly. Besides, oil tends to throw down the scale in large fragments, which accumulate over the furnace plates, producing overheating, bulging and blistering, while seriously obstructing the circulating currents. Oil, when it works its way back of boiler scale, detaches the scale, which falls off, and brings in contact the practically cold water in the boiler with the overheated plates on which the scale was attached. Engineers should always consult with some chemist in these matters, and Geo. W. Lord, the maker of the celebrated Lord's Boiler Compounds, is said to be a competent party with whom to correspond. Mr. Lord is represented in Canada by C. E. Grant, 13 St. John St., Montreal.

ACETYLENE IN MANITOBA.

The following regulations for the use of acetylene gas have been published by the fire underwriters of Manitoba:

(1) No generator shall be located in any building where insurance policies cover that can generate gas under a greater pressure than that sufficient to distribute it through the pipes of a building, or under a greater pressure than that used with ordinary city gas.

(2) Each generator must be properly designed, and have sufficient capacity for the work it has to do, and must be made in such manner and of such materials as to insure durability and stability.

(3) Each burner burning one cubic foot of gas per hour shall have at least one pound of carbide for its supply in the generator when first loaded, to prevent too rapid generation of gas.

(4) No generator shall be installed, the maximum capacity of which is less than one pound of carbide for each one foot burner.

(5) Each generator must be so constructed that when the lights are extinguished the supply of water to the carbide, or the supply of carbide to the water, will cease automatically.

(6) Each generator must be provided with a connection leading out doors, which, in the event of an accidental over production of gas, will convey such surplus to the outside air.

(7) The room in which the generator is placed shall be well ventilated, so that any escaping gas may not be confined in said room.

A SMALL DRY BATTERY.

Something of a novelty in the form of a dry battery has lately been submitted to us for examination by Page Muller, of New York. This cell, which is very compact, stands about two and a half inches high, 1½ by ¾ inches broad. Upon connecting this small cell with an electric bell we obtained just as powerful a ring as a larger dry cell would have afforded. It was also tried on an induction coil with very good results, producing a perfectly steady and strong secondary current. Indeed we should say that it was a very good cell for this last named purpose as it is so light in weight and easily stowed away in the pocket until ready for use. The makers claim that a person starting on a trip for pleasure or otherwise, and wishing to take with him a small medical battery, could find no battery better or more convenient than one of these cells. It would be ready for use at a moment's notice, no difficulty as to chemicals or salts, no cleaning out after use, or any other inconvenience which may be found in many other forms of portable medical batteries. Then take the wire man going to test out a circuit for warehouse telephones or something similar. To him this small battery would prove extremely handy. In conjunction with a testing gauge it could be placed in his pocket and carried about from place to place with the greatest ease. Of course we have only been able to give its good points as they have appeared to us in our tests. The life of the cell, etc., can only be found by constant use, but considering its small size and great strength, we can see no reason why it should not prove useful to both amateurs and professional men. The name of this cell, manufactured by Mr. Muller, is the "Unique Dry Battery No. 1."

CORUNDUM IN ONTARIO.

The following information on the deposits of corundum in Ontario is compiled from the Report of the Ontario Bureau of Mines for 1896:—

In October, 1896, Dr. G. M. Dawson, Director of the Geological Survey at Ottawa, communicated to the Ontario Government the discovery of corundum in the township of Carlow, in Hastings county. This discovery was made by W. F. Ferrier, of the Geological Survey. In 1893 Mr. Ferrier bought a number of specimens collected by John Stewart, formerly of Ottawa, amongst them being a package labelled "Pyroxene crystals, south part of Carlow," which were recognized as corundum. He was authorized in October to visit the township of Carlow to locate the mineral and determine the extent of the deposit. It was found to occur in a coarse grained red, felspathic rock, having the appearance of a pegmatite. This rock, together with a red and brown micaceous gneiss, forms a perpendicular cliff from 80 to 100 feet high, at the base of a sloping mountain. The corundum bearing rock runs into the gneiss side of the mountain along the strike, as well as occurring, as already stated, on the face of a cliff across the strike. Well developed crystals, often of large size, and generally of a grayish or brownish color, as well as irregular masses of the corundum, are thickly distributed through the rock, and the mineral was observed throughout this rock for a distance of about 300 feet across the strike, and traced along the strike more or less continuously for about 700 feet. The grain of the mineral varies with that of the rock. The quantity is not uniform throughout the mass, portions of the rock being more thickly studded with the crystals than others, and in places they seem to form "stringers" in the rock. The interest of the find lies not so much in the possibility of the discovery of the gem varieties of the mineral, ruby and sapphire, about which so much has been said, and which is improbable in view of the mode of occurrence, but in the fact that this is the first time that the mineral has been found to exist in Canada in any quantity, and that it is valuable as an abrasive material on account of its great hardness, which is in a pure mineral next to that of the diamond.

Corundum is an oxide of aluminium, the crystallized varieties being essentially pure, whilst the granular variety, to which the name "emery" is given, contains more or less impurities, chiefly magnetite and hematite. The transparent purer kinds of red and blue colors constitute the gems ruby and sapphire. These usually occur as rolled pebbles in river beds, or as crystals embedded in various rocks, such as limestone, as in the famous ruby mines of Burmah. Statistics show that as an abrasive material there is an extensive market for the corundum. The supply of the mineral in the United States comes chiefly from North Carolina and Georgia, small quantities of emery being also obtained in Westchester county, New York. The finer grades of emery continue to be imported from Turkey and Greece.

Since the present discovery was announced by the Geological Survey, numerous enquiries have been received regarding it, and samples have been furnished to interested parties. Some of these have been tested in the United States, and the corundum pronounced to be of the finest quality. Under instructions of the Commissioner of Crown Lands, a quantity of the mineral was taken out of the Carlow deposit and shipped to the works of the Hart Emery Wheel Company, at Hamilton, Ont., where a test was made of it, but the quantity treated was not sufficient for a satisfactory determination of its value. The report, however, was quite favorable regarding the abrasive qualities of the mineral. Numerous samples were distributed by the Bureau to mineral collectors in the Province, as well as to prospectors, and there is reason to believe that corundum occurs over a wide area in the eastern counties. An interesting discovery was made by George Bennett at a mica mine in the township of Methuen, samples of which have been examined by several experts. George F. Kunz, of New York City, describes it as in part of an excellent blue color, although not of sapphire value, but of abrasive value equal to

any that he has seen from South Carolina, Georgia or elsewhere. Dr. Coleman also made an examination of corundum and another curious mineral from the same location, and in a report upon them says: "The two specimens of corundum are of better appearance than those previously found in Ontario, lacking the soft, decomposed surface seen on former ones. They are also more translucent, and one of them approaches sapphire, having at some points an ultramarine blue color. The corundum is associated with a little muscovite. Both specimens show one well-marked cleavage, no doubt basal, and three less perfect cleavages corresponding to the planes of the chief rhombohedron. The main cleavage faces are striated in three directions, forming equilateral triangles in accordance with the less perfect rhombohedral cleavages. The blue specimen comes nearer to gem quality than any other specimen from Ontario which I have examined."

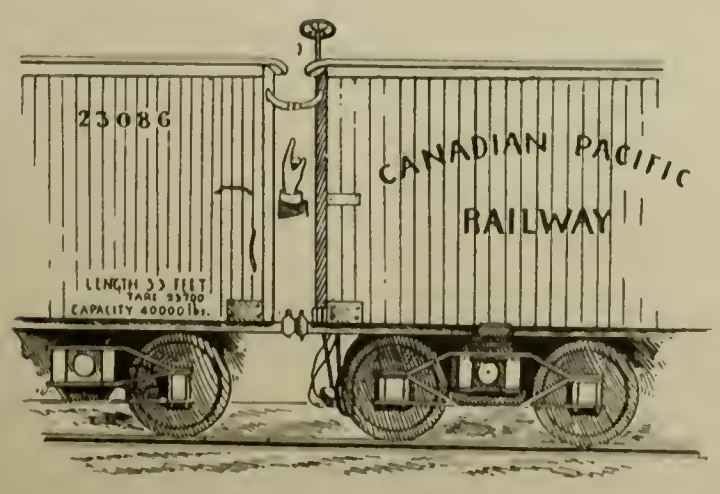
It is necessary that the mineral should be completely freed from the gangue, and this can only be accomplished by a special process. The corundum-bearing rock is first crushed, and then washed by means of sluice-boxes or revolving barrel-shaped cylinders, through which a stream of water passes. But this is not all, for if the fragments of corundum be examined, it will be found that a large proportion of them are coated with a micaceous mineral, having in many instances the composition of margarite, and resulting from the alteration of the corundum. This is removed by passing the mineral through another machine, which, in a form used at one of the principal Georgia mines contains two discs armed with points which are revolved with great rapidity, and soon wear away the soft coating. After undergoing this process the mineral is again washed, crushed and sifted to the various degrees of fineness required. Great care is necessary to prevent its reduction to "flour," as this has only a small value compared to that of the coarser grades. The purpose of all the manipulation it undergoes is to secure uniformity of hardness in the finished material.

Pending further investigation, the lands—which belong to the Crown—on which the corundum occurs in Carlow, have been withdrawn from sale by the Ontario Government, and it is hoped that the deposit will prove as valuable as the surface conditions seem to indicate. It is more than likely that this is not an isolated occurrence, but that other deposits will be found in the Hastings district, now that attention has been called to it. The circumstances attending the present discovery show that the mineral is liable to be passed over or mistaken for something else.

DEVINE'S AUTOMATIC ELECTRIC TRAIN SIGNAL.

The recent successful tests of a new electric train signal on the freight trains of the Canadian Pacific and the Grand Trunk railways have drawn the attention of railway men to the possibility of electric city supplanting compressed air for signalling purposes on moving trains. Every one knows that the present system of signalling on freights is very defective. There is a positive need of some means of rapid communication between front and rear trainmen in cases of accident. The bell-rope is a useless ornament, and, in fact, has been abolished on many American roads. In view of the frequent accidents on freight trains within the past few months, railway managers are awakening to the fact that a change must come in the methods of signalling. To continue the present state of affairs is very unfair to employees, who have lives to save, just as it must be unprofitable to the companies themselves, who suffer yearly losses in rolling stock and freight, amounting to large sums. While compressed air is doing valuable service on passenger trains, it is doubtful whether air will ever be applied to freights for signalling purposes. It is for this reason that we call the attention of railway men to this recently patented electric train signal. It has already given proof of its value and is worth inspection.

Two insulated wires run from end to end of the train, either as a weather-proof cable, like the ordinary bell-cord, or coupled between cars by insulated couplers, as shown in the illustration. The wires are connected to bells and batteries in the caboose and engine cab, and are combined in such manner that front and rear trainmen may signal fore and aft at any time while a train is moving, or a signal may be given to both ends from any car in the train. A code of signals is furnished that puts the driver and conductor in constant communication on the longest freight. The main feature of the signal, however, is the circuit-closing device in the coupler between the cars. It consists of two metal U-shaped prongs, embedded in insulating material, and surmounted by flexible metal tongues, which are made to draw apart, at any time, without injury to themselves. When a train breaks in two, the wires on both ends of the separated cars are automatically short circuited, thus ringing danger signals in the caboose and engine. The recent accidents at Napanee, Iroquois and Guelph Junction, where trains broke in two, causing much damage to rolling stock, would not have happened had they been equipped with this signal.



DEVINE'S TRAIN SIGNAL.

The following extract from the North Bay *Despatch* describes itself.

"Train 115, the fast Soo freight which runs from North Bay to Sault Ste. Marie, was equipped with this signal, on the 14th inst., and was tried in a thorough manner by Supt. Bury of this division, and he expressed himself by saying that this signal supplied a long felt want. Signals were exchanged between him and engineer, and between conductor and engineer, and in no instance did it fail."

REV. PROF. DEVINE.

The inventor, Rev. E. J. Devine, S. J., is a professor in St. Mary's College, Montreal, a gentleman who has a thorough knowledge of railways and railway organization. His patent rights are still in the market. The invention is a valuable one, and has undoubtedly a prosperous future before it as a safety appliance. Its adoption would give railway companies a further motive for applying to the Inter-State Commerce Commission for an extension of time in the matter of air-brake equipment.

STEAM, HYDRAULIC OR ELECTRIC ELEVATORS.

Editor THE CANADIAN ENGINEER.

SIR,—As the question of elevators for the new City Hall, Toronto, is now before the public, I think it would be in order to discuss the subject in THE CANADIAN ENGINEER. The first point to consider with reference to the City Hall is, which is the best kind of elevator for the conditions under which they are to operate, viz., steam, hydro-steam, hydraulic, or electric; the second question is, should the power be generated on the premises; third, the number of elevators; fourth, who is to get the contract.

The whole question being settled with due regard to the kind of traffic and the fluctuations of same, and due consideration being given to general surrounding conditions; the first question must be considered under separate heads, viz., first, cost, safety, reliability, economy, and cost of maintenance. The matter should be dealt with by the city the same as a private individual would deal with it. The question has been already thrashed out by two men who are considered the shrewdest business men in Ontario, and it is safe to say, they did not decide the question because they had an axe to grind; but the choice was made with due consideration of all points, and according to their condition, they chose fairly as well as wisely; the one deciding on electric, the other on hydraulic elevators. Which is the better kind of elevator for the City Hall is easily answered for several reasons, one of which requires no mechanical knowledge to understand. The manufacturers of all kinds of elevators say that the

plant for the City Hall should be hydraulic, except one, who only makes electric machines, who says it should be electric. Now, if a number of men, each tendering on both hydraulic and electric—it making no difference which side of their tender is accepted—say it should be one way, and one man who only tenders on electric, of necessity, says it should be the type he makes, he presents a conclusive argument against his machine.

Cost.—The cost of an elevator plant, like any thing else, can be estimated in different ways and so arranged as to mislead the purchaser. This was certainly done in the city hall tenders, perhaps unintentionally, but as the aldermen are not all mechanics it is necessary to make the matter as plain as possible. The hydraulic elevator will cost less for a complete plant to install; it will also cost less to install the elevators without the power plant; this is a fact, although the tenders would appear to contradict this view at first sight.

Safety.—First cost being less, the next reason is the hydraulic is safer than any other type, from the fact that in water you have something you know something about, and troubles from water are easily noticed, while with electric the least thing will render the plant useless The mechanism for handling the hydraulic is simplicity itself; if the mechanism in the car is moved it moves the main valve, depending on no auxiliary machinery to do the work, and if the valve be closed the elevators will stop, this is because water is practically a solid, and it is like cutting off an iron bar with the valve, thereby positively stopping the piston, which being a slow moving body, is easily brought to rest. In the electric elevator from the time the operator starts to apply the controlling machinery there is a cycle of changes before the car is stopped that is enough to turn a man's hair gray. In the modern up-to-date electric it is more complicated than in the earlier types; and there is more controlling mechanism to one electric than in ten of any other kind, this certainly does not tend to make it safe, for there are that many more chances of derangement. You also use power to stop the electric, as well as start and run it; the more simply an elevator can be started and stopped the safer it is.

Reliability.—In this respect the hydraulic is also best, for the same reasons as make it the safest; also the car in the hydraulic is the fastest moving part, the machinery being very slow and easily handled while in the electric the car is the slowest moving part, the machinery being very fast and complicated. It is subject to great wear and tear, and requires constant attention, the least thing putting it out of order while the hydraulic requires something to actually break to cause a shut down.

Economy.—The hydraulic is the more economical of the two, from the fact that with a good pumping plant of a size that will keep it working moderately steadily, that is, a pump that would be far too small if it was pumping direct to the elevator, is used pumping into a pressure tank from which the elevator takes its water; this tank is partly filled with air, under the same pressure as the water. Under these conditions, when an elevator takes water the pressure falls in the tank a little, and the pumps slowly pump it up again to the pressure that its regulator is set for; if a number of elevators take water together, the accumulated energy stored in the tank is given out to help the pump, and the pump stores more while the elevators are coming down. The pumps by this means are kept more constantly at work than is possible in an engine generating power for electric elevators, except possibly where a storage battery is used, and they have not been proved a success. When an elevator starts, there is no shock to the pump, as the pressure falls very gradually, due to the expansion of the air in the storage tank. Now in the electric plant the machines must be large enough to start all the elevators at once; anything short of this is folly, and would eventually cause an accident. When the elevator takes current the shock is very great, being practically a dead short circuit for the time being; and as there is no reserve, the shock is not only felt by the motor, but also by the generator, the only difference being, the one shock is to a standing machine, while the other is to one running. Now, it is evident to any one that to run a power plant where the average load is only a very small percentage of the maximum, occasions a loss which is much greater than in one where the mean load nearly approaches the maximum. This is the case exactly with electric versus hydraulic elevators. If the steam consumption is measured on a good pumping plant running a certain number of hydraulic elevators, and the steam consumption of an engine running a dynamo supplying current to a like number of elevators under the same conditions, then the economy will be found on the side of the hydraulic. The difficulty is, the electric men want to measure the current at the elevator for the electric plant, and the coal at the coal pile for the hydraulic.

Maintenance.—It is hardly necessary to take up this question, as even the electric manufacturers acknowledge it costs less in the hydraulic than in electric, and it is of necessity so, for the same reason that the hydraulic is safer and more reliable. The only thing to wear in the hydraulic is the piston and valve leathers, while in the electric the expense of keeping high-speed electric machinery in repair is considerable. Weight is added to all this by due consideration being given to surrounding conditions.

Now, sir, as to whether the power be generated on the premises or not, I say "Yes!" The city has already spent a large amount of money in putting in eight boilers, and for the city not to run its own plant is to my mind like a man who builds a factory and lets it stand idle, and buys power from some other source. One-fourth of this boiler capacity is ample to heat the buildings. So if the boilers were put in, knowing the only work they were to do was to heat the building, it was a needless expense putting in so many. In a building where people are sitting writing continuously, it is necessary to have the steam on almost all the year round in some parts of the building, and for say seven months of the year the exhaust of the pump would do this and no more fuel would be used than if the steam were used direct from boilers the balance of the year; if the current for lighting is not generated on the premises live steam would have to be used in addition to the exhaust. If a lighting plant is put in, the exhaust from it, with the exhaust from the pump, will heat it 365 days each year, and during the time the heat is on the building it will require no more fuel than if the heat were off, if the building is piped up right—and I have no doubt it is, as the work was done by competent men.

As to the number of elevators, that will all depend on the amount of traffic, and if it is not to be greater than at the present city hall, it can be handled by three elevators, if hydraulic, with plenty of reserve for many years to come. The two elevators in the Freehold Loan building handle more passengers than the city hall elevators will have to do; and the elevators in the Simpson and Eaton buildings handle more passengers in one hour than the city hall will have to carry in a day. However, the number of elevators is something that nobody will find fault with.

As to who is to get the contract. This is a very important matter. With a private individual, it is settled on the merits of the article, and the advantages to be derived from giving it to a particular party in the way of mutual trade, it is in some cases considered; but it is nobody's business where a private party buys his goods, but with the city, or the country, there is also a principle involved. I don't purpose advocating the asking one man to tender, although I can produce good arguments for the city doing so; but I do say, the city should only allow Canadian firms to tender. The way the Canadian workmen are being treated by our neighbors to the south is a shame, in the light of the manner in which we are treating them, and the only way to bring them to their senses is, when a contract is open, that we can fill as well as they can, to exclude them by all means. But apart from all that, there is the principle of giving to the people who give to you. If the work is kept in Canada, it comes back to ourselves; if it goes out of the country, it is gone forever. When tenders were called for the new G.T.R. gates, at Niagara, the Canadian firms were told that they might tender on the gates for the Canadian side, but their tenders for the United States side would not be considered; but United States firms tendering were told that they could tender for both sides, and of necessity, anyone can build four gates cheaper than they can build two, consequently, the United States firm got the contract, although the Canadian tender was really the cheapest.

It is hard to understand why our people will continually run away to some other place to get what they want when they often have better at home. If Canadian firms got the same show to do work in the United States that we give to United States firms, then it would be only right to let them tender, but the last place they come for anything is Canada. We have United States elevators in this city, both hydraulic and electric, and we have others made by a home manufacturer, and if anyone who is not a bigot and prejudiced against them, no matter how good they may be, will only go to, say, the Bank of Commerce, for hydraulic, and size up both the elevators, and the way they were put in by a United States architect, and then go to the Union Station, or Eaton's, and see the Canadian hydraulic, and the way they are installed, it will be a revelation.

Surrounding Conditions.—The conditions would suggest a hydraulic plant, from the fact that the city has a very very costly building, which is not fire-proof; in fact, the upper parts of which are a fire trap. This requires the best fire protection attainable, which a good elevator pump gives, because, unlike a fire pump that stands for a year, and when a fire occurs it is found to be out of order, the elevator pump is running every day, and if it is not attended to every person coming into the building will know it, on account of the elevators not running; whereas a fire pump might be out of order, and no one would know it. And judging the city hall plant by the rest of the city, it will not be attended to any better than the law allows. The great fluctuations of traffic in a building like the city hall will be taken care of better by hydraulic than by electric elevators, because when the elevators stop the pump stops also, and all steam consumption ceases, and when the traffic is heavy the pumps will work practically all the time, but in an

electric plant the machine generating the power is running all the time, giving a percentage of loss, for it is either full load or no load. The great difficulty is that people are getting into the habit of thinking that if anything is electric it must be the best; that is true in some cases, but those who have had to do with electric elevators have found them to be Jonahs. Consumers of current usually think they are robbed, but when a man pays his bill for current for running his elevator he should laugh in his sleeve for he has got all, and more than all he has paid for. The electric elevator is a curse to a lighting station; they have hurt the incandescent lighting business more than anything else; so much so, that the Toronto company has put nearly all the elevators on a separate current. Now, if a large company has to do this, when an elevator adds such a small percentage of load to the station, it is plainly to be seen how much more it would affect a private plant. If the city will have electric elevators let them buy the power, as the Ontario Government does for the Parliament buildings, even if they can generate it as cheaply in connection with their lights.

Now I am by no means through with the question, but will not take up any more of your valuable space, except to say that if the city will have electric elevators, they need not go to the United States for them. The Robert Simpson Company's electric elevators are the best that are running in Toronto, and if they can handle the traffic of a department store, they can easily handle the traffic of the Court House and City Hall. I hope this matter will be taken up by engineers and dealt with in the interests of the Canadian workmen with fair play to all. Yours truly,

E. J. PHILIP.

AN UNUSUALLY LARGE ELEVATOR.

An unusually large elevator has recently been put in the new building of the T. Eaton Company, cor. James and Louisa streets, Toronto. The cylinder is 26 inches in diameter and 24 feet long; the travel of the car is 60 feet; the car is built of steel, and is supported by ten ¾-inch steel cables, and has a platform 17 feet 6 inches by 10 feet. The carrying capacity of the elevator is seven tons, which is the largest elevator with rope machinery in the city. The purpose of the elevator is to be able to run a loaded wagon on to the car, and run it off at the floor where the material is to be unloaded, thus saving handling so many times. This elevator, as well as all the 12 elevators in the company's store, were built by the Fensom Elevator Company, Duke street, Toronto. This is the largest elevator plant in Canada, and it certainly is a credit to the company. The plant is most varied in the character of the work which it performs, from the smooth-running passenger elevator, handling thousands of passengers each day, and the fast-running freights, to the slow-running direct lifts; and last, but by no means least, this mammoth, which has lately been installed. Another novel feature on the T. Eaton Company's premises is the power grooming and clipping machines in the stable, that can clean or clip a horse in almost less time than it takes to tell it. These are driven by two 2 h.p. electric motors, built by the Toronto Electric Motor Co., as also a 15-h.p. motor for cutting and grinding feed. The stable building is heated by steam and lighted by electricity, and is equipped with Grennell sprinklers (dry system), and seven hundred and fifty feet of 2½-inch standard fire hose arranged on each floor. The capacity of the stable, as arranged at present, is one hundred horses.

THE DOHERTY IRON CASTINGS PROCESS.

The recent sale for a large sum, of the British patents of the Doherty process in iron foundry practice, will render a short description of the process of interest to our readers, especially as the discoverer is a native Canadian. The process consists in introducing into the tuyere (or mouthpiece by which the blast is brought into the cupola) a jet of steam, with the result that the casting is made finer in the grain, softer and tougher than is ordinarily the case, and this improvement applies, not only to castings made wholly from pig iron, but from scrap also, the loss being only two per cent. in some cases where scrap is used. It has long been known that humidity in the atmosphere has an effect in iron smelting, but it remained for Thomas Doherty, of Sarnia, by a happy accident to follow up this obscure and uncertain effect till the problem came within his control.

When scrap is used in a foundry a large amount of the oxide of iron is carried off with the slag and lost, this loss being about 30 per cent. in ordinary practice. The introduction of the steam jet—in which the elements of hydrogen and oxygen exist—has the effect of producing a more strict form of metallic iron through the removal of the oxygen from the oxide. In his foundry in Sarnia, Mr. Doherty uses one part of second quality foundry pig and three parts of low-grade scrap with malleable to the extent of not more than 300 lbs. to the ton, the result being a stronger, softer, and more uniform casting than can be obtained in the old way. Various foundries that have adopted the process state that they have saved from $4 to $5 per ton, according to the kind and price of raw material used. Though the principle is the same in all cases, the application of Mr. Doherty's process varies according to the work of the foundry, the iron used, and the purposes the castings are turned to, and judgment and experience will determine the success of its adoption in each case. For example, one class of pig iron may contain a certain amount of silicon, carbon, phosphorous, manganese and sulphur, and another class contain exactly the same proportions of these substances, yet the two irons will not give the same casting, although melted in the same cupola and under the same conditions. Then we must arrive at the conclusion that there must be a variation in the metallic iron, and in our present state of knowledge chemistry cannot give the character of it, and the consequence is that we are never sure of the same results, even on the same analysis. There may be a variation of 10 per cent. in strength in the castings made from the two irons. Mr. Doherty believes that the introduction of steam produces a molecular change in the casting. This should be conclusive evidence that hydrogen is a powerful reducing agent, that its influence in reduction of the oxide of iron in an ordinary cupola plays a very important part, and aside from this most valuable feature it has other valuable functions, namely, softening and strengthening the castings.

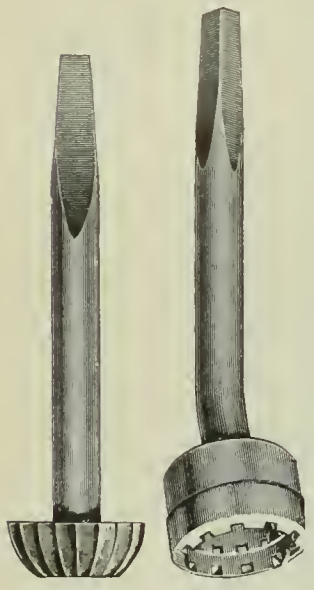
THOMAS DOHERTY.

Thomas Doherty was born near Perth, Ont., in 1854. His grandfather was a British half-pay officer, who had settled in Bathurst township, and his mother was born in Manitoulin Island, when the island was almost a wilderness. Mr. Doherty's family came to Plympton, about 20 miles from Sarnia, where they settled as farmers, but had a small shop on the farm, in which the subject of our sketch picked up with a quick instinct a knowledge of mechanical matters. They moved to Watford, where they ran a small foundry and machine shop, at which they made threshers and other agricultural implements. When Mr. Doherty was 13 years old his father died and he was left to carry on the business—a great undertaking for one so young—but he succeeded well, and fifteen years ago moved to Sarnia and established the foundry business which he still carries on in that town. It was in 1894 that he discovered the process which has made his name so widely known in the iron founding world to-day. This discovery, like so many others, was the result of an accident. The blower had got overheated, and he sent a boy up on the roof to pour water down; the water was sucked into the cupola, and its conversion there into steam had, to his surprise, a marked effect for good on the iron; he began to study the cause, and the result was the process already described. The process is secured by 21 patents in Great Britain and various countries, a company having been formed to operate in England with a capital of £100,000, paying Mr. Doherty £30,000 cash and an interest to the extent of 12 per cent. in the company. This company is known as the Doherty Iron Castings Process, Limited, with offices at 32 Victoria street, London. In the United States a company called the Doherty Iron Castings Process Co., of Ridgway, Pa., has been formed, the company paying him $150,000 for his rights. The Canadian business will be controlled by Mr. Doherty himself. It will be of interest to mention that the patents for this process at first hung in doubt in Great Britain. The claim was in the use of hydrogen "in fixed proportions," and was exactly analogous to the patents for the cyanide process of gold extraction which were being contested in the courts. Cyanide had been used before for extracting gold, and hydrogen had been used in iron melting: but

neither had been commercially a success, because a knowledge of the proper proportions had not been gained. The validity of the cyanide patents having been upheld by the highest authorities in patent law, those of Mr. Doherty's process became secure on the same grounds.

FACING TOOLS.

T. Draper of Petrolia, Ont., manufacturer of valve facing tools and ball valves, sends us his new descriptive circular containing cuts of the tools, which we reproduce here. As will be readily seen from the cuts, the device is very simple, and it is claimed for the tools, that the work done by them is very accurate, and that valves dressed with them are perfectly tight. Only a common bit brace is required to operate them, and this is at hand almost everywhere. No more preparation is necessary than to put the tool in the brace and do the work.



SEAT FACER. VALVE FACER.

FIG. 1.

Fig. 1 shows a pair of the tools for repairing common globe valves. The seat facer or reamer is a section of a true ball or sphere, so that it makes a concave seat. The valve facer, for facing the disc, is so constructed that it makes a surface to fit accurately the surface formed by the seat facer.

Fig. 2 shows the tool for facing all flat-seated valves.

Fig. 3 is from a photo of the actual operation of repairing a globe valve.

Figs. 4 and 5 show three positions of the valve facer in its revolution, They also show the valve disc *C* jammed tight against the part *D*, to prevent it turning, while being dressed.

JENKIN'S OR FLAT SEAT FACER.

FIG. 2.

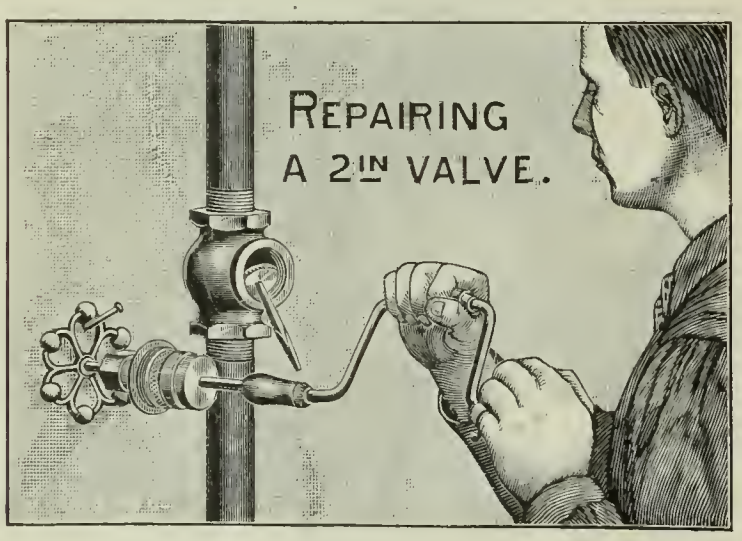


FIG. 3

Note particularly that the tool travels in the direction indicated by the arrows. It swirls or sweeps around the disc. This pecular motion is obtained by having the driving shank bent, as shown in Fig. 5. This cup tool has an inner and an outer cutting edge, as will be seen by Fig. 1.

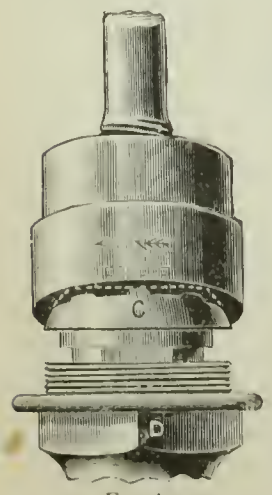


Fig 4.

These tools make practically a ball and socket joint, which is admitted to be the best form and the right principle. Mr. Draper informs us that he is continually making sales all over the United States and Canada, and that the numerous users report the tools to be very satisfactory. His advertisement will be found in another part of this paper.

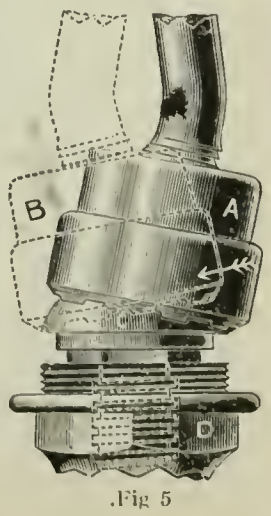


Fig 5

SPENCE & Co., file manufacturers, Hamilton, have put in a new file cutting machine, with a hammer of 160 lbs., one of the heaviest of the kind in Canada. The machine was made by Charles James, machinist, of the same city.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during October, 1896, 1897, and the ten months to October, 1896-1897.

	Month of Oct.,		Ten months ending Oct.,	
	1896.	1897.	1896.	1897.
Hardware and cutlery	£6,296	£7,921	£53,163	£58,593
Pig iron	4,974	1,187	26,204	6,485
Bar, etc.	1,443	306	14,049	7,878
Railroad	13,756	6,885	171,909	45,778
Hoops, sheets, etc.	6,919	15,307	42,677	71,261
Galvanized sheets	4,760	13,439	46,972	48,986
Tin plates	18,580	30 122	110,489	162,971
Cast, wrought, etc., iron	4,298	2,932	44,949	28,889
Old (for re-manufacture)	736	1,292	15,598	6,483
Steel	6,809	6,440	79,869	47,501
Lead	2,793	4,888	13,279	23,950
Tin, unwrought	1,861	1,169	13,577	14,983
Cement	6,445	2,880	31,031	18,491

WASHING AND BRIGHTENING STONE WALLS.

W. P. M., HALIFAX.—If you have the information, will you please answer through THE CANADIAN ENGINEER, giving a method of cleaning the soot and dirt which collects on the front of large freestone buildings, without going over the building with a tool. The soot is from soft coal and is driven in with the dampness.

ANSWER.—In removing soot from stone buildings nothing is so satisfactory as chisel work. For brightening up the stone walls brushes of steel wire are sometimes used, but this process does not penetrate far enough. Various washes and enamels have been used and advertised for this purpose, but we should advise you to be very chary about their use. In most cases they are composed of dilute solutions of muriatic acid. This preparation is often used to wash brick walls as well as stone, with the result that both mortar and stone are eaten into and crumble away. In many cases where architectural work has been spoiled, these washes are the unsuspected cause. Various kinds of enamels are also used, in which case the sooty surface is covered up by the application, but this enamel soon begins to wash off in patches, making the building look worse than before. Next to tooling cut stone architecture is rubbing them down with wet bricks of "grit" composed of any sandstone, washing off after the operation.

THE ELECTRIC RAILWAYS OF CANADA.

There are at present in Canada 569 miles of electric railway, exclusive of those of British Columbia. The valuable statistics compiled by George Johnson, the Dominion statistician, show that the train mileage run of these roads in 1896 was 21,917,151, and the number of passengers carried was 73,496,069. The total capital and bonded debt was $23,000,000. There were in use 947 motor cars, with 1,315 motors, 360 trailers, and 62 street sweepers and snow plows. The total number of hands employed was about 3,400. In the statistical year book for 1896 detailed returns are given of five electric railways reporting to the Department of Railways and Canals, as follows:

	Miles long	Train mileage run.	Paid up capital.
Berlin & Waterloo	2.75	66,000	$28,350
Ham., Grimsby & Beamsville	17	207,001	189,700
Montreal Park and Island	14 43	42,653	770,401
Niag. Falls Park and River	13.68	221,535	1,281,731
Oshawa	8.50	23,258	311,704

	Passengers carried.	Tons freight.	Earnings.	Expenses.
Berlin & Waterloo	205,000	.....	$ 8,200	$ 6,880
Ham., Grimsby & Beamsville	256,313	2,142	36,040	28,926
Montreal Park and Island	728,204	.....	56,446	55,879
Niag. Falls Park and River	474,552	.....	58,688	36,271
Oshawa	87,519	16,389	11,900	16,700

SEWAGE VENTILATION.

Editor CANADIAN ENGINEER:

SIR,—The *Canadian Architect and Builder* for November reports a paper read by J. W. Hughes, master plumber, of Montreal, before the American Public Health Association at Philadelphia, wherein Mr. Hughes enforces the systems and ideas of drain ventilation and construction so ably described in THE CANADIAN ENGINEER of April, September, and November, by W. M. Watson, master plumber, of Toronto. This is a good sign that the dangerous sanitary plumbing and drainage by-laws forced on the public by interested and selfish

persons and law makers will soon have done all the mischief it will be allowed to do. If this should meet the eye of Mr. Hughes, I might inform him that the by-laws controlling such matters for Brantford, Ont., will probably meet both Mr. Watson, Mr. Hughes, and every sanitarian's views who works for the good of the country. It is hoped that these two experienced sanitary plumbers will encourage still more of the kind to speak the truth boldly, and stop the scandalous and expensive abuse of the public health laws.

Yours truly,

A CONSTANT READER.

Toronto, Nov. 21st, 1897.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting on Thursday, Nov. 11th, Prof. H. T. Bovey, LL.D., D.C.L., read a paper on the "Results of Experiments on the Strength of White Pine, Red Pine, Hemlock and Spruce." The paper was followed by an interesting discussion in which Messrs. Peterson, Smith, Irwin and Duggan took part.

The ballot sheets for the election of officers for next year are now in the hands of the voting members. They are accompanied by one or two amendments to by-laws, which will probably effect some changes in the conduct of the society. Under the present laws, all past presidents are *ex-officio* members of the board; and the number will, of course, be increased yearly. The voting members fear that the control of the society may soon pass out of their hands if some change is not made, and an amendment, signed by nineteen voting members, proposes that three of the past presidents be elected to the board, instead of all as at present. The office of secretary is also the subject of an amendment. At present the secretary is always a member of council. It is proposed to separate these offices.

Mining Matters.

THE Jenckes Machine Co., Sherbrooke, Que, reports British Columbia sales as very satisfactory.

HON. G. E. FOSTER authorises the statement that Rothschilds offered half a million for the Olive mine, half cash and the remainder in stock. The offer was refused.

J. C. MASON, Manager of the Hopewell gold mine, New Glasgow N.S., reports prospects at the mine bright. A 79 ounce brick was the result of a recent run of 21 days.

THOMAS WHITTAKER, 135 Bathurst street, Toronto, has a farm in the Nipissing district, Ont., on which he has discovered fire clay, extending over 15 acres, and ranging from twelve to fifteen feet in depth.

THE Hamilton Powder Co. is equipping its Nanaimo works with a new hoisting plant, having placed an order with the James Cooper Manufacturing Co., Limited, for a standard link motion hoisting engine.

THE Eustis Mining Co., Eustis, Que., has commenced sinking again in its shaft, and has placed an order with the Jenckes Machine Co., Sherbrooke, for special underground hoists to be worked by compressed air.

THE Winnipeg Mining and Smelting Co., Greenwood, B.C., is developing its property, and has installed a complete mining plant, purchased from the Rossland branch of the Jenckes Machine Co., Sherbrooke, Que.

THE Bonanza Nickel Mining Co., Limited, Sudbury, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, for a 10-stamp mill, complete, with two six-foot vanners. It is the intention to install this mill immediately.

BY a recent judicial decision in British Columbia it has been decided that no matter where a mining company may be incorporated, or under what terms it holds its charter, the transfer of its property in British Columbia is subject to the laws of British Columbia.

THE Sarnia *Observer* says the Bushnell Oil Company, Limited, is pushing things in Lambton county, and are thoroughly testing the territory in the vicinity of Sarnia to see if oil can be found in paying quantities. It is reported that extensive finds of both oil and gas have been made.

J. A. Bows reports to the Bureau of Mines from Wabigoon, under date of Nov. 14, on the district lying about eight miles south of Tache Station on the C.P.R., and around Shallow, Stormy and Long Lakes, and the Little Wabigoon River. Mr. Bows says in his letter: "From all appearances, I would think that it will prove one of the richest sections of the country."

THE New Goldfields of British Columbia Co proposes to actively take up the development of its several properties in the Kootenay district, and is, at present, opening the Velvet mine, in which there are several promising showings. It has a new hoisting engine plant installed, which was supplied by the James Cooper Manufacturing Co., through the British Columbia agent, James D Sword.

THE new mining district in Calumet Island, Ont., on the Ottawa River, is coming to the front: there has been some preliminary work done, and on the "Calumet" property this has opened up showings so promising, that the company has placed an order with the James Cooper Mfg. Co. for a complete drilling, hoisting, and pumping plant Even if present indications only are a criterion, this will make one of the largest mines in Canada. The company, however, thinks that with depth it will prove even richer than the present assays disclose.

THE outlook for cheaper coal and coke in the East and West Kootenay districts is very promising, the reports from the West are that work has been proceeded with so actively on the Crow's Nest Pass Railway, that it has been graded to within 20 miles of Moyie Lake Simultaneously, the Crow's Nest Pass Syndicate is engaged in prospecting work with the diamond drill outfit, which was ordered through the James Cooper Mfg. Co., Limited, and it is expected before the completion of the railway to have opened the property to such an extent as to supply the local demand at least.

THE absence of railway communication has retarded the opening up of the Boundary country to a great extent, but notwithstanding the difficulties that have to be surmounted in getting machinery in, several of the companies which have had enough preliminary work done to warrant their putting in a plant, have decided to haul their machinery in by wagon road. The Brandon and Golden Crown Mining Co. has decided to proceed actively with development work, and has placed an order with the James Cooper Manufacturing Co, for a complete hoisting, pumping and drilling plant, which is now on the ground. As soon as this is set up a large force of men will be put on the work.

Railway Matters.

THERE seems to be a strong probability that the G.T.R. will double track the line from Hamilton to Niagara Falls.

THE Ottawa and New York Railway Co. have offered to build their workshops in Ottawa if they are given a bonus of $100,000.

IT is said that the G.T.R. will have running rights over the new Toledo & Northwestern Railway, thus getting into the Ohio coal fields.

THE Grand Trunk Railway Company has sent cheques to Brantford amounting to $33,500, returning the car works bonus with interest.

SHIRLEY ONDERDONK, son of Andrew Onderdonk, the railway contractor of Hamilton, has gone to Alaska to assist in surveying a railroad.

THE Tilsonburg, Erie and Pacific R. R. is constructing a connection at Tilsonburg, Ont., with the M.C.R. and will build a $20,000 steel bridge across Otter Creek.

THE Lotbiniere and Megantic Railway Company is building a wharf 160 feet long at Cap a la Roche, Que., to facilitate the shipping pulp wood, bark, etc., from that section.

A SUB-COMMITTEE of the Montreal city council has recommended the granting of part of Victoria Square, Montreal, to the Grand Trunk Railway as a site for an office building.

THE Q.C.R Company are about to extend their shops at Newington, near Sherbrooke, Que., which will require an expenditure of not less than $70,000. The contracts have not yet been let.

A CHARTER is applied for by a company which proposes to build a railway from Cranbrook, B.C., to the North Star mine, thence to headwaters of St. Mary's River, and Kootenay and Arrow Lakes.

THE T H. & B took control of its own road on Dec. 1. The M.C.R. officials went out and the head office was transferred from Detroit to Hamilton, Ont. The new manager is E. Fisher, of Jackson, Michigan.

AN agreement has been signed between the Nova Scotia Midland Railway Company and the Nova Scotia and Federal Governments, by the terms of which each of the latter agree to subsidize the road to the extent of $3,200 per mile, for the construction of a railway from Windsor to Truro. W. G. Reid, of Montreal, has the contract to build the road, which is to be fifty miles in length.

THE bridge over the Columbia River carrying the Red Mountain tracks to Rossland, B.C., has been tested for traffic. It is a composite structure of wood and iron of six spans, in length about 2,000 feet.

AT the present time the Grand Trunk Railway System is having the heaviest run of freight in the memory of the oldest employees. The company has ordered the construction of a thousand new cars—500 in Detroit, and 500 in the Canadian shops.

THE G.T.R. is doing a good deal in the way of improving its property. An oil house will be erected at London, Ont., and a new roundhouse at Sarnia. The new Berlin station is to be completed by Christmas, and the capacity of the freight sheds at Wiarton is to be doubled.

THE Hudson's Bay and Pacific Railway Company has applied for an amendment to their charter, to abandon the projected line from Prince Albert to Calgary, and to establish instead, the branch between Prince Albert and Edmonton, and to a point at or near the Yellow Head Pass.

AN important innovation is being made on the Canadian portion of the Grand Trunk Railway system, in substituting compressed air for steam as a motive power in their shops. It is said to be cheaper than steam, and has been applied successfully in the shops at Toronto, Belleville, and other places.

A CURIOUS accident occurred on the Canadian Pacific, near London, Ont., the other day. An engine was running light to the repair shops just ahead of a train, when suddenly the axles broke, the sidebars fell from the sides, and the steel tires of the driving wheels broke in several places, causing a complete wreck of the engine.

STRATFORD, ONT., demands $25,000 from the Grand trunk, which is the amount which Stratford gave the railway company to erect and maintain a roundhouse in the place, and it is claimed that the Grand Trunk is breaking the agreement with Stratford by removing engines and crews from that place to Sarnia, where a new roundhouse is being built.

MR. HEINZE and the Canadian Pacific have failed to come to terms, and Sir William Van Horne has made the following statement: "It is absolutely necessary that we should reach Rossland with a line of our own, and we are under pledge to Rossland to do so. We would have preferred the purchase of the Trail Creek road, which could have been adapted to our purposes by a considerable expenditure, but we could not come to terms, and we are now obliged to go on with our own work."

THE CANADIAN ENGINEER has received a copy of the official report of the directors of the Grand Trunk Railway Company of Canada, together with the statement of accounts for the half year ending June 30th, 1897, which shows that the working expenses have been cut down from 71.34 per cent. of the gross receipts to 67.49 per cent. of the gross receipts for the corresponding half year. This decrease means a saving to the shareholders of £55,677. While the company's passenger traffic decreased during the six months by 0.12 per cent. the freight traffic increased by 1.49 per cent.

THE following have been elected directors of the Great Northern Railway: Messrs. P. Garneau, John Sharples, Frank Ross, V. Chateauvert, T. H. Deann, Jules Tessier, and Veasy Bosweli. The annual report mentions the completion and acceptance of the ten-mile section constructed by Paquet and Fortin, from Grand Mere to Shawenegan, and a branch line built by the company and the Laurentine Pulp Company from the St. Maurice to the latter's mill. It also states that a bonus has been offered by the council of Three Rivers if the terminus and workshops of the road are placed there, and that the question must shortly be decided.

Marine News.

JAS. PLAYFAIR & SON, Midland, Ont., will build a large tug at Midland this winter.

RYAN & MACDONALD have been awarded a contract for sections 1 and 2 on the Soulanges Canal.

STR. "JUBILEE" has been bought to run on the Pelee Island route by a Leamington, Ont., firm.

MACDONALD & MOFFAT are making satisfactory progress on the new $10,000 wharf at Pugwash, N.S.

THERE is talk of a new C.P.R. steamer for Lake Memphremagog, between Newport, Georgeville and Magog, for the coming summer.—*Granby, Que., Leader.*

THE Montreal Transportation Company launched a new steel barge at Kingston, Ont., recently.

ST. JOHN, N.B., this winter, will have the heavy freight landed on her docks; Halifax will receive the mails.

THE str. "Empress of India" is to undergo extensive repairs and alterations, at Picton, Ont., this winter.

THE steamer "Sir S. L. Tilley" is to have 60 feet added to her length of 180 feet, making her the full size of the Welland Canal locks.

THE Beaver Line Steamship Co. has chartered the "Gallia," which is about 450 feet in length, being as large as the "Parisian," and the "Bothnia."

HENRY FOLGER says there will be a daily service between Clayton, N.Y., and Montreal, next season, with the possibility of extension to Quebec and the Saguenay.

THE Dominion Government is taking steps to improve the navigation of the Rainy River. It is also understood that the Fort Frances lock is to be at once improved.

AT Kingston, recently, the locomotive works turned out and launched a steel barge, the "Coburg," 180 feet long, 35 feet beam, and to carry 50,000 bushels on a draft of 11 feet.

MESSRS. TROOP & SON, of St. John, have placed an order in England for the building of a new steel steamer. She will be 300 feet long, 45 feet beam, and will be named the "Canada."

THE str. "Stranger," running between Valleyfield and Montreal, sunk in Lake St. Louis, recently, in 25 feet of water. The hands on board managed to get ashore after considerable hardship.

WM. TWOHEY, a former lake captain, died recently in Toronto. He was in his eightieth year, and came to Canada from England in 1837. For many years he sailed between Toronto and Chicago.

THE steamer "Lakeside," St. Catharines, Ont., is to be sailed by Capt. N. J. Wigle next season, it is said, and it is reported that another boat will be put on the run along with the "Lakeside" between Toronto and St. Catharines.

SINCE his return from England, McLeod Stewart, Ottawa, announces that the building of the Ottawa Valley-Georgian Bay Canal will begin in the spring. The cost will be $15,000,000, and Sir Benjamin Baker will be consulting engineer.

IT is said at Vancouver, B.C., that the C.P.R. management intend to run the "Empress" steamers direct to Australia, by way of Honolulu and the Fiji Islands. Better boats will be put on the Japan route, and a weekly service will be substituted for a monthly one.

ROBT. BOWIE, N. Cossitt, T. Wilkinson, J. Grant, sr., D. Derbyshire, and Jas. Cumming, Brockville, Ont, are among those interested in the new boat to be built this winter for service between Brockville and Union Park, Thousand Islands. Davis & Son, Kingston, Ont., will, it is said, build the boat.

IT is proposed to build a steamer in Annapolis, N.S., this winter, to ply between St. John and points between Digby and Bridgetown, touching at Bridgetown, Round Hill, Annapolis, Grenville, Digby, Bear River and St. John. It is expected to put the new steamer in commission on April 1st, 1898.

THE Department of Railways and Canals has taken over the contract on the Soulanges Canal held by A. Stewart, Ottawa, and the work is being carried on under the control of the Government. The contract included sections 1 and 2, and comprised some heavy masonry work and the excavation and building of three large docks.

BESIDES the building of two large steamers for the Richelieu and Ontario Company for lake passenger traffic, at the Bertram Engine Works Co.'s shipyards, the iron grain steamer "Rosedale," belonging to Crangle & Hagarty, is to have a new hurricane deck. The iron steamer "Seguin," 200 feet long, will be lengthened about 40 feet.

THE Montreal papers have recently revived the old scheme of deepening the water in the channel below Montreal, not by dredging, but by building a dam at Deschambault, where the Richelieu rapids occur. This would, it is claimed, give an extra depth of eight or ten feet at Cap a la Roche, and from four to six feet extra water in Lake St. Peter.

THE new pier on the east side of the entrance to the harbor of Port Dalhousie, Ont., and the Welland Canal, the work on which has lately been successfully completed, is recently described in the St. Catharines *Journal*. It is thirty feet wide at the inner, sixty feet wide at the outer end, about five feet above high water mark, and 2,000 feet long. The first section of the work was done about five years ago by day labor, and the next year a section was let by tender to John Riley & Son, contractors, St. Catharines, who were followed next season by Battle & Newman, Thorold and St. Catharines. Last year the final section or end running into the lake was awarded to John Riley & Son. The work was under the supervision of W. G. Thompson, the resident

engineer and canal superintendent, and T. Crowley acted as overseer for the Government, with Thos Riley superintendent for the contractors. The work throughout was constructed of concrete, and cement was supplied by the Thorold Hydraulic Cement Works, estate of John Battle, proprietors.

Wm. Thomson & Co. have closed with Russell & Co., of Port Glasgow, for the construction of another steamer similar to the "Cheronea," "Platea," and "Arbela" (now building). She will be launched in April or May, and her dimensions will be as follows: Length of keel, 325 feet; breadth of beam, 48 feet; depth of hold, 26 feet 6 inches. She will be called the "Cunaxa." This vessel will be the fifth steamer added to the Messrs. Thomson's fleet.

Four of the passenger steamers sailing from Toronto were last season commanded by Picton men, says the *Times* of that town, namely: Captain Harry Solmes, of the new steel palace steamer "Corona"; Captain Robert Clapp, of that favorite steamer "Chicora"; Captain George O'Brien, of the favorite steamer "Empress of India"; Captain William Van Vlack, of the steam yacht "Cleopatra," also Captain Nelson Babbit, of the Toronto Ferry Company's line.

The Bessemer Steamship Company, which is John D. Rockefeller's line of lake steamers and barges, has just closed a contract for the three largest ships on the lakes. The contract for these boats, one steamer and two consorts, was given to F. W. Wheeler & Co., Bay City, Mich., to be completed in May, 1898. The steamer's dimensions are 475 feet over all, 455 feet keel, fifty feet beam, and twenty-nine and a half feet deep. The engines will be quadruple expansion, the cylinders measuring twenty-eight, forty, fifty-nine, and eighty-five inches in diameter, with forty-two inches stroke. The barges will be 450 feet long, fifty feet beam, and twenty-eight and a half feet deep. They will carry 7,000 gross tons each. The boats will cost between five and six hundred thousand dollars. The Bessemer Company is figuring with other builders for two more boats of the same displacement for future delivery.

Electric Flashes.

Noble & Barber, electrical contractors, have started in business in Montreal.

Brantford, Ont., is making estimates on a civic lighting plant. The present lighting contract expires next year.

At a meeting of the Stratford city council last month, it was decided to advertise the electric street railway franchise for sale.

The Royal Electric Co. is shipping the Hamilton Electric Light and Power Co. one of its single-phase 2,000 light alternators with station apparatus, etc.

The successors to the electrical supply business of C. W. Henderson, Bleury street, Montreal, are Taylor, Telfer & Co., who will continue business at the same stand.

The Kingsville Electric Light and Power Co. has placed an order with the Royal Electric Co. for a 50-light 6½ amp. arc machine, with lamps for lighting the streets of Kingsville, Ont.

Roberval, Que., is to have an electric light plant. B. A. Scott, who has the matter in charge, has placed an order for the Crocker special turbines with the Jenckes Machine Co., Sherbrooke, Que.

The American Rattan Co. has just completed its new factory and is moving to the town of Walkerton, Ont. It has bought from the Royal Electric Co., for lighting the factory, a complete electric lighting equipment.

Premier Turner, of the British Columbia Government, has stated that the Government is ready to assist the C.P.R. in constructing a telegraph line from Telegraph Creek, on the Stickeen River, to Teslin Lake, the head waters of the Yukon.

Moodie & Son, Terrebonne, Que., agricultural implement manufacturers, have completed their new factory and are lighting the same throughout with electricity. The order for the electrical apparatus has been placed with the Royal Electric Co., Montreal.

The St. Jerome Electric Light Co., St. Jerome, Que., has bought from the Royal Electric Co., and is installing in that town a 50 k. w. "S.K C." two-phase alternating current dynamo, with Stanley transformers, etc. There will be 750 lights installed when it starts up.

The Crystal Beach Electric Street Railway Company, Limited, has been incorporated. The directors of the company are: H. W. Olmsted, C. P. Olmsted, O. B. Englisch, Oakfield; H. P. Thompson, Buffalo, N.Y.; L. Beecher, Batavia, N.Y., and A. O'Heir, Hamilton, Ont.

The Hull, Que., Electric Company has purchased the Aylmer branch of the C P R, which is at present under lease, the price being in the neighborhood of $100,000 Since leasing the road the Hull Company has double-tracked it from Hull to Aylmer, and improved the roadbed.

The Hamilton, Ont., Street Railway Company's receipts have decreased considerably this year, as compared with those of last year, the decrease being attributed to the increase of bicycles in the city The returns for the quarter ending September 30th show a falling off The total revenue for the quarter is nearly $4,000 less than in the same period last year.

The Canadian General Electric Co. is building a power house and a pumping station at the Peterborough works. The contracts have been let as follows: Iron and steel work, the Hamilton Bridge Co.: window frames, St. Lawrence Foundry, Toronto, galvanized iron work, Douglas Bros., Toronto.

A. G. Fraser, London, is suing the London Street Railway Company for $15,000 damages. He was pushed towards the edge of the platform, came in contact with one of the iron stays of the bridge the car was crossing, and fell a distance of about thirty feet. He claims the accident was due to the negligence of the company.

The Windsor Electric Light and Power Co., Windsor, N S., whose plant was destroyed by the late fire, has immediately started to rebuild, and has given an order to the Royal Electric Co. for apparatus and transformers, etc., consisting of "S K.C." alternators and Stanley transformers. The ashes of the old station had hardly grown cold before the order for the new apparatus was placed.

Geo. C. Rankin, London, promoter of the Chatham city and suburban electric railway, has withdrawn from the provisional company, Angus Sinclair, Chatham, taking his place. S. R. Miller and W. D. McRae, Detroit, have been elected to the board. The intention of the company is to secure the necessary amendment to their charter for the extension of the road north and south, and to push the work of construction.

The Grand Trunk Railway has arrived at an agreement with the Hamilton Radial Railway Co. to allow the latter a crossing at Burlington, in return for the abolition of the level crossings over the G.T.R. line at Sherman avenue, and over the H. & N. W. division, near the beach. This gives the Radial a route into Oakville, Ont., and the extension will probably be built.

The Canadian Cotton Mills Co., Milltown, N.B., has closed a contract with the Royal Electric Co. for a 30 k.w. "S.K.C." two-phase dynamo wound to deliver 110 volts to the service mains. Within the last eight weeks this is the third large manufacturing establishment to install one of these machines of the Royal Electric Co.'s make, the Penman Manufacturing Co., Paris, Ont., and the Cockshutt Plow Co., Brantford, being the other two.

Johnston's Electrical and Street Railway Directory for 1897 will be issued January 1st. This work contains complete and accurate lists of electric lighting companies, isolated plants, telephone, telegraph, street railway, and other electrical companies of the United States, Canada and Mexico, with full information regarding each, including the names of superintendents, purchasing agents, etc.; also lists of manufacturers of and dealers in electrical and street railway appliances.

The Deschenes Electric Company, Limited, has taken out a license to supply electric light and power in the city of Ottawa and county of Carleton. The company, which was granted a charter in January, 1896, obtained from the Dominion Government the right to lay cables from the Ottawa River at the foot of the locks on both banks of the Rideau Canal to the canal basin, agreeing in return to supply electric current free for the lighting of the canal locks, basin, etc. The directors of the company are: W. J. Conroy, R. H. Conroy, Alex. Fraser, David Maclaren, and Charles Magee.

The corporation of Fort William, Ont., is about to erect as complete an electric lighting plant as, perhaps, is in use in any town in Canada. There is being installed one 50-light 2,000 c. p. arc dynamo, with 35 double or all night lamps for lighting the streets of the town and the C. P. Railway yards, and for the incandescent service, and "S.K.C." alternating current dynamo with a capacity of 1,000 lights, with "Stanley" transformers throughout. The corporation expects to be in a position to furnish light by the 1st of January next. The electrical equipment has been bought from the Royal Electric Co., and the engines and boilers from the Robb Engineering Co., Amherstburg, N.S.

In the case of Lepitre vs. the Citizens' Light Co., we mentioned the judgment against the company for $1,000. The details of the accident are as follows: The young man was employed one evening passing wires along a beam in a cellar, under which beam were wires

charged with electricity at the time, as they served for lighting purposes. The whole space between the live wire and those at which Lepitre was working was about fifteen inches, and having come in contact with the current, he was killed. The court held that the company must be held responsible as having been guilty of negligence in not properly insulating the wires when work was being done under such dangerous circumstances.

According to the financial statement presented to the shareholders of the H, G. & B. Electric Railway at their last quarterly meeting held recently, the railway is making money. For the months of July, August and September there was an increase of $3,125.93 in passenger receipts, $342 in freight and $1,033 in express receipts over those of the corresponding quarter last year. The total receipts for the quarter were $16,913.87, as against $12,430.91 for July, August and September of 1896. In August of 1896, 29,192 passengers were carried, and in August of this year, 47,700; in September, 1896, 19,647, and September, 1897, 26,776. The expenditure for the quarter ending Sept. 30th, this year, was $2,715 01 less than for the same quarter last year.

Personal.

We are much pleased to hear of the restoration to health of Sir Casimir Gzowski, C.E.

H. A. J. McLeod, C.E., will be the Government engineer in charge of the Drummond Counties Railway.

A. R. Macdonald has been appointed superintendent of the Intercolonial Railway between Montreal and Levis, Que.

R. J. Reed, the well known contractor, Montreal, who has been ill at his home in Montreal, left for California recently in a private car.

At the International Geographical Congress held at St. Petersburg a short time ago, Mgr. Laflamme, rector of Laval University was elected one of the vice-presidents.

John Chisholm Macnab, a member of the Red River expedition, civil engineer at Chatham, Ont., died at the home of his father, 111 Elgin street, Hamilton, recently. He was 46 years of age.

The Toronto Technical School Board has appointed H. P. Elliott, a graduate of Toronto University and of the School of Practical Science, to the position of teacher of electricity and the steam engine.

Geo. H. Frost, of the *Engineering News*, New York, was a fellow student of Dr. Robt. Bell of the Geological Survey, in civil engineering at McGill University, and graduated only a short time before Dr. Bell.

The death is announced at Jersey City Heights, recently, of Wm. Moore, a former citizen of Quebec. He was engaged as city surveyor during the introduction of the first Quebec water works. Subsequently he was first manager of the old Quebec Street Railway, when he became manager of the Quebec Steamship Company, of which, in late years, he has been New York manager.

S. J. Turkington died recently in his 73rd year. The greater part of a very useful life was spent in railroad contracting. When the Grand Trunk Railway was building through the eastern portion of Ontario he superintended the construction of a large section for three years. He afterwards built a portion of the R.W. & O.R.R., the Lake Shore, the Midland, and also railroads in New Brunswick and the Southern States. On retiring from active contracting he settled in Mallorytown, Ont., and for five years discharged the duties of customs' officer, being relieved of office some three years ago.

The death occurred at Montreal, November 14th, of Frederick Fairman, president of the Dominion Barb Wire Company. The sad event was the outcome of a cold contracted the previous week while superintending the construction of some new houses, and which developed into pneumonia. Mr. Fairman was born and received his early education in Gananoque, Ont., and graduated with considerable distinction from Victoria University, Cobourg. He entered the machinery and manufacturing firm of D. S. Abbott, Gananoque, and subsequently acquired an interest in the business, which he carried on until 1874. He was then for five years with the Montreal firm of Moreland, Watson & Co., when he bought a retail business in Waterloo, Ont. In 1882 Mr. Fairman returned to Montreal and entered into the partnership of Cooper & Fairman, which was dissolved three years later. It was at this time that Mr. Fairman accepted the presidency of the Dominion Barb Wire Company. He was also for a time connected with the Dominion Bridge Company.

Ink that will adhere to glass is produced in the following way: Twenty parts of brown lacquer are dissolved in 150 parts of alcohol and mixed with a solution of thirty-five parts of borax in 250 parts of distilled water. The mixing should be done slowly, one part of methyl-violet being added. The ink thus produced is very lasting, and can be used to advantage instead of labels on glass bottles.

Brief, but Interesting.

The Schwarz aluminum air ship, fitted with a benzine motor, was tested last month in Berlin, Germany, in the presence of a number of generals and others. The air ship rose to a great height, floated in the air for 12 minutes, and, at first, obeyed the man steering it, but later he was unable to steer it against the strong wind which prevailed. The experiment was considered to be partly successful.

The oldest piece of gold wire of which the world has any knowledge is a specimen made in Nineveh some 800 years B.C. Solid gold drawn wire is now, states *Science Siftings*, practically unknown in the trade. However, gold wire is made in the following manner: Silver rods are coated with gold in the proportion of 2 per cent. of gold to the weight of silver to be manipulated. When the gilding is performed the rods are about 1¾ inches in diameter by 2 feet 6 inches long, and weigh about 400 ounces each. The two metals are then drawn down together, first through steel dies, and afterward through drilled rubies or diamonds. The process of drilling the gems is kept a secret. A better idea of the minuteness of some of these borings may, however, be learned from the fact that the holes cannot be discerned by the naked eye, and only by the aid of a magnifying glass can one be convinced that they really exist. For the manufacture of silver and silver-gilt wires the silver is sometimes bored out and internal copper rods are inserted, and they are then drawn together. Wires as fine as a human hair, for example, .003 inch in diameter and even finer, can be gauged by instruments termed "micrometers." The scales for weighing the gold coin at the mint are so exquisitely fine that they can detect the most minute particle added to either side of the balance. There are fine woven wire gauzes and cloth, some of which are made with as many as 40,000 meshes to the square inch. The more delicate classes of wire find application in scientific instruments. So fine are these that it is difficult to get them measured; but the task has been accomplished, and platinum wire has been drawn $\frac{1}{7000}$ of an inch, and to even greater fineness. Aluminum wire has been drawn as fine as 10,500 yards to the ounce, a size too fine to be practically measured by any gauge or instrument.

Industrial Notes.

The new flour mill at Goderich, Ont., is now in operation.

A start has been made in erecting the new flour mill at Wolfville, N.S.

A new $10,000 school building is to be built at once at Sackville, N.B.

A sewage system for Pembroke, Ont., to cost $16,000, is under consideration.

An engine is being placed in the Granby, Que., Rubber Co.'s machine shops.

The E. B. Eddy Co., Hull, Que., is spending $20,000 in perfecting its fire protection system.

The plant of the Vulcan Iron Works Co., Winnipeg, has been bought by John McKechnie

John Bertram & Sons, Dundas, are very busy building heavy machinery for shipping abroad,

The Boys' Home, Montreal, has received donations amounting to $8,000 to be expended in building.

Favorable progress is being made on the piers for the Saskatchewan bridge at Edmonton, N.W T.

J. Honeyman and E. J. Watson, architects, are employed on the new school building, Rossland, B.C.

A bridge to cost about $10,000 is proposed to connect Sydney, Cape Breton, with the Intercolonial pier.

Among the busy Hamilton concerns is the machine shop of Charles James, who is now turning out, among other work, 2,000 shoes for seed drills for the North-West. This firm has just put in a new 30-inch drilling machine from the well-known tool makers, John Bertram & Sons, Dundas, Ont.

The Cappison Pipe and Boiler Covering Co. have recently supplied their Standard Abestos Magnesia sectional covering to various concerns, the orders aggregating nearly 12,000 feet. Among the mills so fitted up are the new mills of the Holland & Emery Lumber Co., who have recently removed from Michigan and built two large saw mills at Byng Inlet, on the site of the mills of the Georgian Bay Lumber Co., burnt some time ago. The new mills are fitted with band saws, circular saws, lath and shingle saws.

ANNAPOLIS, N.S., has had plans for a sewage system prepared.

THE Granby, Que., last works are putting in a forty-five horse-power boiler and engine to run their works.

THE city of Sherbrooke, Que, and the Street Railway Co. will build a new bridge over the river St Francis.

WM. DAVIES & Co., Toronto, propose to establish a large pork-packing establishment in the Maritime Provinces.

A. THOMS, Fort William, Ont., has invented a seat for use in locomotive cabs which has a special arrangement of springs.

THE Jenckes Machine Co., Sherbrooke, Que., is building a 20 x 10 crusher for the Wilson Carbide Co., St. Catharines, Ont.

B. MOONEY & SONS, St. John, N.B., have received a contract for a brick block of five buildings for T. R. Davison, Windsor, N.S.

THE Windsor, N.S., Foundry Co. has secured temporary premises and is carrying on business almost as usual. The works will be rebuilt.

PLANS have been prepared for the erection of a new theatre and opera house near St. John's gate, Quebec city. Its estimated cost is $60,000.

THE town of Kingsville have taken over the natural gas plant, which has been operated by a private company. The price was $18,000.

JAS. KAY, Aylmer, Que., has been appointed boiler inspector and issuer of engineers' and firemen's certificates in the Province of Quebec.

I. MATHESON & Co., New Glasgow, N S., have recently shipped several car loads of buoys to the Pacific coast for the Dominion Government.

GEORGE MCARTHUR, St. John, N.B., has been awarded the contract for building Doran's Hotel, Windsor, N.S. The price is over $20,000.

AT the next session of the Ontario Legislature, the city of Toronto will ask an amendment of its charter enabling it to carry on the business of cold storage.

IT is said to be probable that the McClary Manufacturing Co., London, Ont., will establish a branch for the manufacture of enamel ware in St. John's, Que.

E. METHOT, of Cap St. Ignace, is intending rebuilding his saw mill and installing two 40 h.p. boilers, to be furnished by the Jenckes Machine Co., Sherbrooke.

THE city council of Sherbrooke is passing a by-law to raise $35,000, of which $15,000 is for a new bridge and $14,000 for the completion of the sewage system.

THERE is a good prospect of an hospital being built at Maniwaki, Que., as $10,000 has been raised already, and the Quebec Government is expected to make a grant.

GEO. ANDERSON, Canadian Trade Commissioner to Japan, reports a great demand in that country for boilers, engines and machinery generally.

MONTREAL manufacturers are to be obliged to abate the smoke nuisance. Where electric power is so easily obtained as in Montreal, there should be no trouble from smoke.

PETER REID, of Lemesurier, Que., is installing a new engine and boiler, bought from the Jenckes Machine Co., Sherbrooke, which will largely increase the capacity of his sawmill.

SPENCER & SPENCER, Frelighsburg, Que., are enlarging their sawmill, and for this purpose have placed an order with the Jenckes Machine Co., Sherbrooke, for a 25-inch special Crocker turbine.

THE city of Hamilton, Ont., is offering the Heinze Pickle Co., Pittsburg, tax exemption for ten years and a reduced rate for water supply for the proposed Canadian branch.

THE Toronto Cold Storage Company, Limited, has been incorporated. The incorporators are: F. C. Jones, G. B. Jones, H. F. Darrell, Sarah Darrell, J. Massie, Toronto.

THE acetylene gas machine recently installed by James Boxall, in the R. C. Presbytery, Downeyville, Ont., has been tested, and gave satisfaction. It is a 20-light machine

THE Grand Trunk Railway has come to an agreement with the town of Collingwood, Ont., for the erection of an elevator there. The town will give twenty-five thousand dollars.

H. R. MCLELLAN, known as the pioneer lumberman of the Gulf of St. Lawrence, will shortly establish a lumber mill on the Marguerite River, where he controls large timber limits.

J. W. WURTELE & Co., Ottawa, Ont., are making magnabestos sectional covering, which is claimed to effect a saving of 25 to 40 per cent. in fuel, by covering boilers, furnaces, etc.

BUILDING operations have not been begun by the Hamilton and Toronto Sewer Pipe Company, Hamilton, Ont., and it said that the company does not propose to build till next spring

THE Victoria Foundry Co, Ottawa, Ont., manufacturers of water wheels, power house plants, rotary pumps, automatic hose reels, etc., report business improving and the general outlook bright

THE business of Rogers, Robertson and Co, oil merchants Montreal, has been amalgamated with that of the Bushnell Company, Limited, and Duncan Robertson becomes connected with the latter firm.

GILLIES BROS. are not only rebuilding their saw mills at Braeside, but will shortly build one at Madawaska, Ont., on the K & P.R R, for the manufacture of cedar ties, shingles, basswood, elm and ash lumber.

W. H. MELDRUM has purchased the Paris rollers mills, at Paris, Ont., from Crane & Baird, of Toronto and Montreal. Wm and J G. Greey, Toronto, mill furnishers, are putting in plant of 200 barrels capacity.

THE Royal Victoria Hospital, which Lords Mountstephen and Strathcona presented to Montreal, at a cost of $2,000,000, has already grown too small, and the governors are considering plans for a $100,000 extension.

THE Canadian Engine and Locomotive Works, in Kingston, have been notified that they will get the contract to build three locomotives for the Intercolonial Railway Company. The company will tender for seven more.

THE Chicoutimi Pulp Co., Chicoutimi, Que., have decided to extend their mill, and have placed an order with the Jenckes Machine Co., Sherbrooke, for nine 10-plate screens, an additional Crocker turbine, and a 50 h.p. boiler.

THE Brothers of the Sacred Heart of Arthabaska purpose erecting a college building a hundred and fifty feet long, fifty feet wide, and four stories high, at St. Hyacinthe, Que. It will be built of stone and brick, and will cost about $50,000.

W. H. PERRIN, O. Carss, A. Foster, A. Patterson and J. R. Lavell, Smith's Falls, Ont., have been incorporated as The Perrin Plough Company of Smith's Falls, Limited, to manufacture agricultural implements. Capital nine thousand dollars.

THAT Canada may develop a large export trade in paper to Japan is evident from the fact that Taylor Bros., of the Don Paper Mills, Toronto, recently received an order from a Japanese importing firm at Yokohama, for 110 tons of paper.

THE firm of Major Bros. & Co., Montreal, manufacturers of cardboard, tar paper, etc.; contemplates moving to Cornwall, Ont. They would need a site of ten acres, with a water-power, and would build a paper mill employing forty to fifty hands.

BUSINESS is very brisk at the Calcium Carbide Works, Merritton, Ont. A car load of carbide was shipped recently to the Yukon, via New York, where it will be shipped around Cape Horn. Three car loads were also shipped to Europe and one to Mexico.

THE provisional directors of the Duryea Motor Co of Canada, Limited, which is applying for a Dominion charter, capital $250,000, are: S. Rogers, T. Eaton, Toronto; H. Edwards-Ficken, New York, U.S.; G. H. Hewitt, Springfield, Mass., and G. W. Yarker, Toronto.

PRICE BROS., Quebec, have placed an order with the Jenckes Machine Co., Sherbrooke, for one of their special refuse burners, 18 feet in diameter, 120 feet high, for their Montmagny mill. This is the second burner of this size which the Jenckes Company has supplied them.

THE city council of Brantford, Ont., has voted $15,000 to buy from the Verity Plow Co. the premises recently burned. If the company accepts this offer, it will be obliged to go on with its business in Brantford. The works began to run regularly after the fire on Nov. 13th.

LAWN FARM, Mattoon, Ill., consisting of 250 acres, has been sold for $17,450 to Grand Chief P. M. Arthur, in trust for the benefit of the Brotherhood of Locomotive Engineers. It is the intention of the Brotherhood to establish a home for dependent engineers, their widows and orphans.

THE boiler of the Royal City saw mills, Vancouver, B.C., exploded at noon recently while the men were eating dinner around it. Several men were killed and many injured. The roof of the mill was blown off and the building wrecked. The noise of the explosion was heard outside of the city limits.

THE Acetylene Lighting Company, Limited, applies for a Dominion charter to carry on a lighting business in London, Ont. Proposed capital, $15,000. The incorporators are: W. J. Stinson, London, Ont.; C. S. Grosch, S. G. Grosch, Milverton, Ont.; M. M. Stinson, London; W. R. Stinson, St. Thomas, North Dakota, U.S.

THE large Jewell filters for the town of St. Hyacinth are being installed. These filters were built throughout by the Jenckes Machine Co., of Sherbrooke, and the work reflects great credit on this firm.

H. ROBERTSON, J. Arnett, D. McLean, A. Spicer, I. Groh, W. E. Roark, J. A. Rourke, R. Simpson, H. F. McDonald, T. Cain, A. Robertson, J. F. Snowball, Shallow Lake, Ont., have been incorporated as the Shallow Lake Woodwork Manufacturing Company, Limited. Capital five thousand dollars.

THE purchase of a controlling interest in the Vancouver Gas Works by Wm. Mackenzie, of Toronto, on behalf of a strong syndicate, is of interest and importance to our province's mining, says the *Mining Critic*, in view of the necessarily close connection of successful gas production with coal mining.

G. A. LANDON and F. A. Landon, manufacturers, and E. B. Landon, traveller, of Toronto, and James H. Taylor and James Kellam, of Etobicoke, farmers, have letters patent to manufacture carriages and carriage supplies, under the name of the Carriage Specialty Co., of Toronto, Limited; capital, $20,000.

THE work on the Lawrencetown, N.S., water system is nearly completed, and will cost about $9,000. Two reservoirs have been constructed, the upper one at an elevation of 250 feet and the lower one 135 feet. The capacity of the latter is nearly 100,000 gallons. Twelve hydrants will be placed in town and about fifty house services put in.

THE Goderich Boiler Works recently turned out a ditch digger, built somewhat after the plan of a dredge, having an endless chain on which are a number of knives and iron buckets. It is some 20 feet high and mounted on trucks 20 feet long and 10 feet wide. It was run by a threshing machine engine, and in clay or sandy soil made excellent time.

THE plans for the Nepean Point Bridge have been prepared under instructions from H. J. Beemer, president of the Ottawa and Gatineau and Pontiac and Pacific Junction Railways. Mr. Beemer has sent copies of the plans to various bridge contractors in Canada and the United States, and will ask for tenders at once.

ONE of the largest penstocks ever used in connection with the development of water powers in Canada is being built at the works of the Laurentian Pulp Co, Grande Mere, Que., on the St. Maurice River. The main penstock is 14 feet in diameter, made from 7-16 in. steel plate, 550 feet long, and with its branches has used in the neighborhood of three hundred tons of plate. The Jenckes Machine Co., Sherbrooke, Que., has this contract.

A PORTION of the assets of the Young Co., Limited, of Brampton, Ont., Soil Pipe Foundry, amounting in value to $7,700, has been sold to the Toronto Hardware Company by the assignee, F. H. Lamb, of Hamilton. The building and plant remain unsold, and it is said that it is likely that the town of Brampton will have to take it over and add it to the collection of such things they have acquired by their system of liberal bonus giving.

ST. LAWRENCE Anchor Fence Company, Limited, applies for a Dominion charter to manufacture fences and gates, etc., in Montreal. Proposed capital, $20,000. The incorporators are: G. F. Benson, D. W. Campbell, W. L. Chipchase, G. J. Crowdy, W. Ewing, P. Galibert, J. L. Gilmour, E. K. Greene, W. A. C. Hamilton, J. Johnston, G. W. Lovejoy, M.D., F. G. Lyman, and Hon. A. Thibaudeau, Montreal; A. Dickson, Longue Pointe; J. M. Elder, M.D., Westmount, Que.

THE machinery of Paxton, Tate & Co., mill machinery manufacturers, Port Perry, Ont, has been sold to Adison Williams. This was nearly all the available assets of the firm, and, owing to secured claims, the ordinary creditors will receive nothing from the estate. The assets are expected to realize about $7,000, with liabilities of over $4,718.69, of which $1,103.59 are preferred securities held for $8,169.06. The Ontario Bank holds a secured claim for $6,900.

AT the sixth annual meeting of the Foundrymen's Association held at the Manufacturers' Club, Philadelphia, November 3rd, there was read a paper on the subject of "The Practical Value of the Various Metalloids in Cast Iron," by Malcolm McDowell, 606 E. 46th street, Chicago, Ill., who has a national reputation as a metallurgist. His paper was full of interest, and treated on the so-called semi-steel that is now being made by several foundries from cupola metal and poured in green sand; its tensile strength being about 40,000 lbs.

SITUATION WANTED by young man, 22 years of age, as salesman, to travel Maritime Provinces. Have traveled three years with bicycles. Good references. Address I. E. CORNWALL, St. John, N.B.

KLONDIKE A mechanical engineer of steady habits and general experience, going to the Klondike in the spring, to take up and work a claim, is desirous of meeting "a mate." References exchanged. Address "BOB," care of Canadian Engineer, Montreal.

SITUATION WANTED—Young man, practical machinist, at present engaged in the editorial office of a mechanical newspaper in New York, desires similar position with Canadian publication devoted to the same interests. Stenographer (speed, 150 words per minute) and typewriter. Age 24 years. Address M. C., care Canadian Engineer.

For Sale Cheap

A New 100 Kilowatt 125 Volt Muitipolar, Direct Current Dynamo

latest steel frame type, with iron clad armature.

A most complete set of Station Attachments. Suitable for Incandescent Lighting, with a capacity of 2,000 16-candle power lamps, or for power or electro-chemical purposes; has never been used only for a test.

For particulars apply to E. H. HILBORN, 74 Brunswick Avenue, Toronto, or to JOHN TOLMIE, Kincardine.

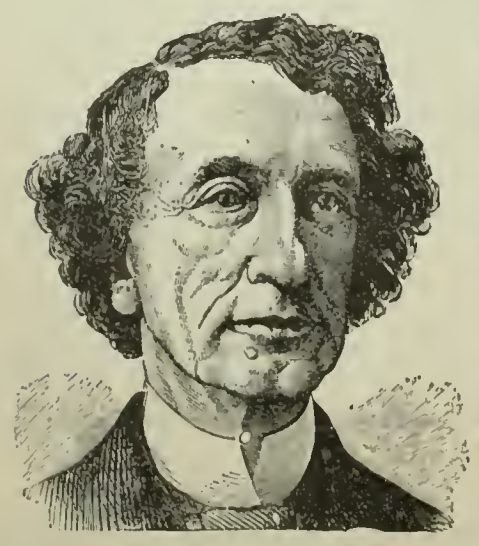
The Ontario People's Salt and Soda Company, Limited

The Londonderry Iron Company, Limited

THE DIRECTORS of the above company having authorized us to negotiate for the disposal of its extensive properties and works at or near Londonderry, N.S., we are prepared to submit a schedule and to treat with reliable parties. The properties consist of about 30,000 acres of selected mineral lands held in fee simple, free of royalties, besides a further extent of mining rights, two blast furnaces completely equipped, two ore calcining kilns, sixty-seven coke ovens, a large rolling mill, a pipe foundry, a general foundry, a well equipped machine shop, about twelve miles of railway, with four locomotives, cars, etc., etc., numerous houses and all the plants incidental to the production of iron on a large scale.

MACDOUGALL BROS., Montreal

A BETTER CHRISTMAS GIFT



62 Church Street, Toronto,
or Fraser Building, Montreal.

Could not be given to the old folks than a copy of "The Anecdotal Life of Sir John Macdonald." It is at once the most interesting biography and the best collection of his jokes, repartees and witty sayings ever published. As one of the reviewers put it, "it is a biography, joke book, history and anecdote book all combined in one." No Canadian work has had so large a sale in the book trade. "The Anecdotal Life of Sir John Macdonald" (330 pages, cloth, with illustrations) is now out of print and scarce. A very small number of copies have been recovered and may be had at $2 00 post-paid. They will not last long, so write quickly.

Address **Biggar, Samuel & Co.**

The Canadian Engineer

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The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. V.

ROADBED CONSTRUCTION.

ARTICLE 18. LARGER WATERWAYS WITH HEAVY EMBANKMENTS.

When a single box culvert 4 by 5 feet in cross section or, with very long covers and corbels, possibly 5 by 5 feet, will not carry the maximum flow of a stream, we must either use double or treble box culverts or an arch culvert. The intermediate walls of double box culverts may be made pointed to divide the flow of water, and a screen or paling may be erected some distance up stream to catch driftwood, but, even at best, their use is doubtful for the same reasons as for double lines of culvert pipes, *i.e*, the danger of logs, etc., choking up the entrance; whether an arch culvert of equivalent area will be cheaper than such a structure will depend on the availability of brick, cement or cheaply-cut stone for arch sheeting on the one hand, or of large-sized stones for covers on the other.

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

ARTICLE 19.—ARCH CULVERTS.

The selection of materials for the construction of arch culverts will depend on circumstances; where good weathering stone can be easily quarried and cut in the vicinity it will be usually used, but if stone is scarce or costly, and well-burnt brick plentiful, then brick may be found cheaper; of course brick so soft as to be unable to stand erosion or frost should never be used on exterior faces or for the arch sheeting. The use of concrete for arch culverts is yet a very occasional one in America, but is likely to steadily increase as we have more skilled civil

Plate VII

scale 1 in - 8 ft

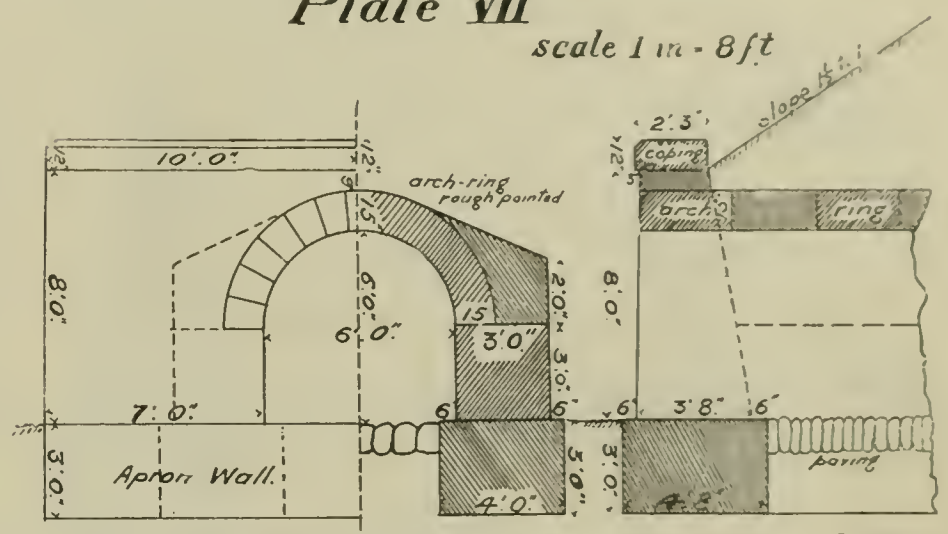


Fig. 33. 6' Stone Arch.

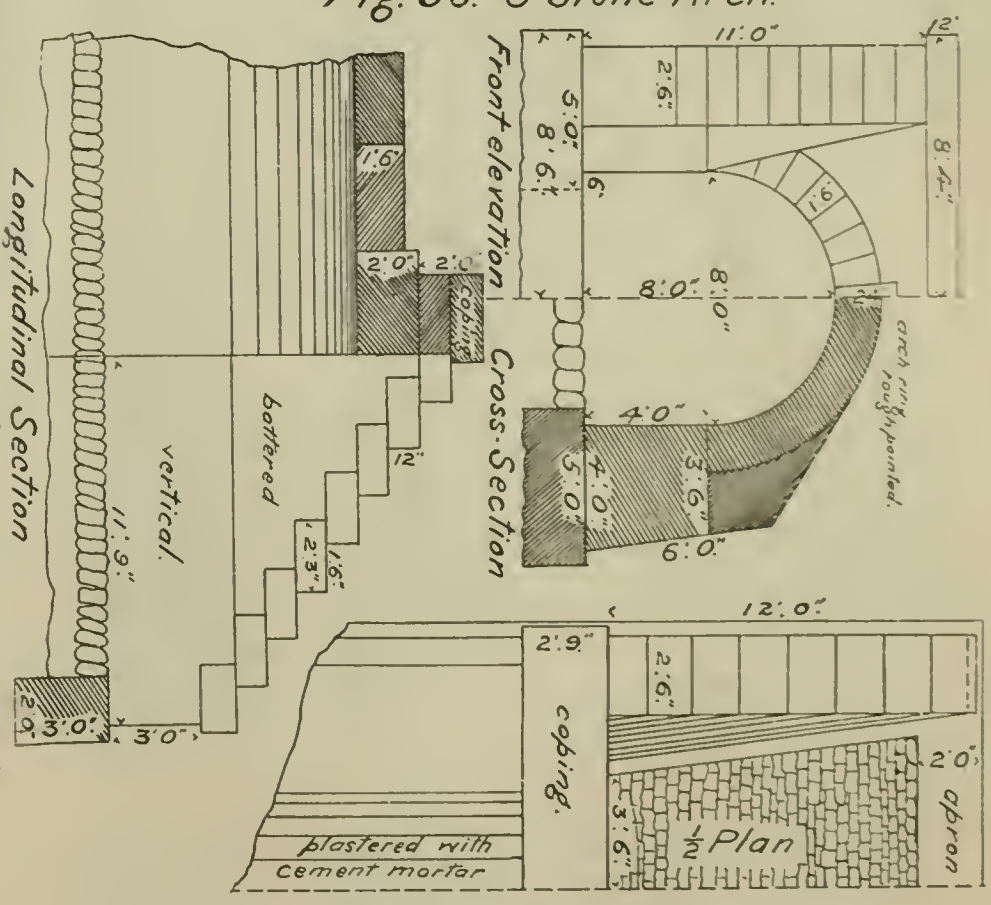


Fig. 34. 8' Stone Arch.

engineers who are familiar with the production of a cheap concrete with superior exterior finish, capable of standing frost and erosion and certain to remain sound for an indefinite number of years, which necessitates using absolutely sound, high-grade cements, and until an engineer has the opportunity of making certain of his cement by systematic testing, he is advised to avoid the use of any but the very smallest monolithic arch culverts, although, of course,

their construction presents no structural difficulties, beyond the precaution of defining occasional lines of separation in the arch sheeting so as to avoid irregular contraction lines.

Plate VIII

scale 1 in. = 12 ft.

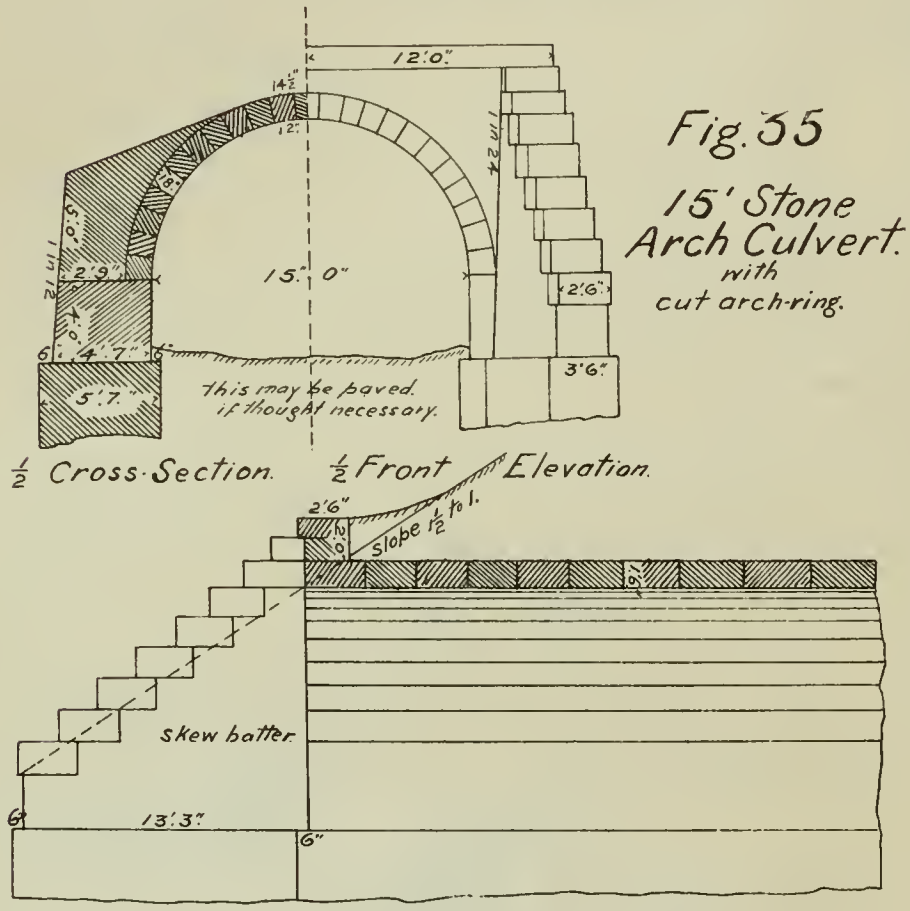


Fig. 35
15' Stone Arch Culvert with cut arch-ring.

The chief features of arch culvert designing are:—

(*a*) The shape of the end walls.

(*b*) The depth, class and form of the arch sheeting.

(*c*) The dimensions of the arch abutments.

(*a*) The shape of the end walls will depend on the span of the arch and its rise.

For small semi-circular arch culverts, say from 5 to 8 feet span, the retaining head-wall shown, Plate X., Fig. 39, and Plate VII., Fig. 33, is generally used; for segmental arches of somewhat longer span the same may be advantageous, but as soon as a larger retaining wall becomes necessary its use should be abandoned in favor of stepped wings; the reason for this is that a surcharged retaining wall, with nothing but mortar to bond it to the back of the ring stones and often loaded with wet, slippery clay filling, is liable to be displaced, unless made very heavy, and thus the designs, as shown, Plate VII., Fig. 34, and Plate VIII., Fig. 35, of the types shown on Plate X., are found more suitable. The choice between straight wings and flaring ones, or between wings flush with the faces of the barrel of the arch, and those set back clear of the ring stones will depend much on the taste of the designer; for small spans liable to catch driftwood the choice should rest on flush wings, with some flare to avoid contraction, but with larger spans, of say 15 feet or over, a wing set back so as to show the arch ring stones will have a better appearance, and give equally good or better bond between the wing and the abutment or parapet wall. The small parapet wall of a culvert with stepped wings is well buttressed and very stable; the wings themselves usually have a face batter of 1 in 12 to 1 in 24, and a section at any point suitable for a level retaining wall (*i. e.*) about $\frac{4}{10}$ height + batter, their length will be economically curtailed at a point where the steps are 2 feet or 3 feet above the ground level. Stepped wings are preferable to those with inclined copings, as the latter are liable to become dislodged in time, and do not give an easy means of climbing the bank, and, also, the coping of a parapet wall of a brick arch culvert should preferably be a stone one, as bricks are liable to be displaced by ties, boulders, etc., rolling down the bank.

(*b*) The form of the arch will depend on the depth of bank; wherever headroom permits, a semi-circular arch is used, partly because the arch sheeting stones are less expensive than those for any other than segmental arches, being all cut from one template, and partly because the abutments need not be so heavy; but as the quantity of cut arch sheeting is greatest in a semi-circular arch the saving is not very great on the structure as a whole, but when the depth of bank is the limiting feature, a much greater waterway can be obtained by the use of arches of small rise to span, elliptical, segmental, or basket-handled, at a slight increase in cost. In small arches, it is cheaper to use roughly cut or even rubble arch sheeting of a greater depth, than to build one of first-class cut stone of less depth; but as the span increases, the economy of carefully cut and bedded arch sheeting will point to the use of the minimum depth. The workmanship on stone arch sheeting should be of the quality figured on, and if cut stone is called for, it should be as shown in the upper diagram of Fig. 40, because if left narrow at the back, the mortar that fills up the discrepancy being weaker and more compressible than the stone tends to throw excessive loads on the inner faces of the stones; this is a point over which too great an amount of inspection can hardly be given, especially if the stones are of minimum depth. When deep rubble arch sheeting is used, the mortar will be strong enough to stand the pressures allowed.

Plate IX

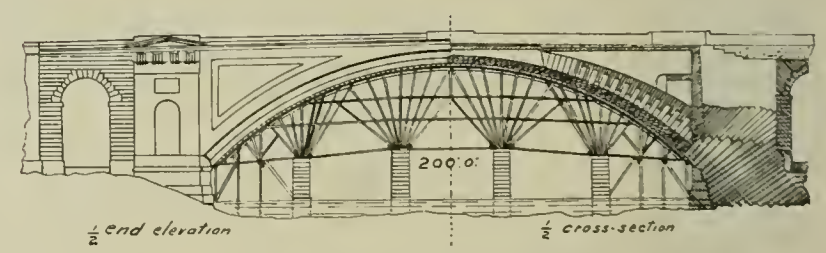


Fig. 36 Segmental Arch with centres still in place

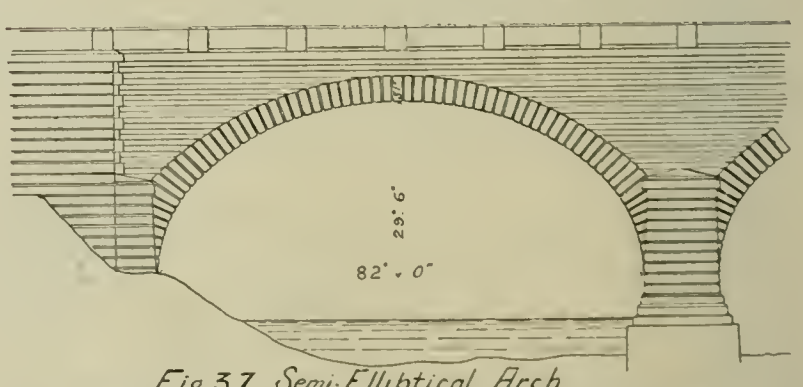


Fig. 37. Semi-Elliptical Arch.

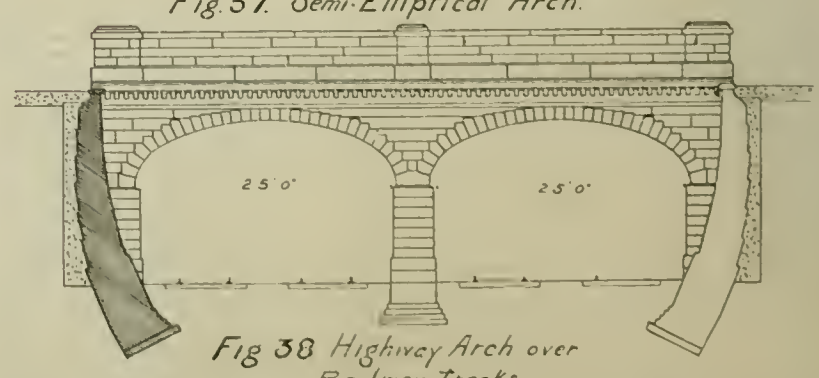


Fig 38 Highway Arch over Railway Tracks.

If arch sheeting is of brick a greater depth must be allowed usually than for stone, unless the brick is of very good quality and well bonded, and as bricks are not usually made bevelled unless for a very large contract, and are all of a uniform size, the bonding of the several rings of brick in arch sheeting of several bricks in depth is not possible except at arbitrary intervals, depending on

Plate X

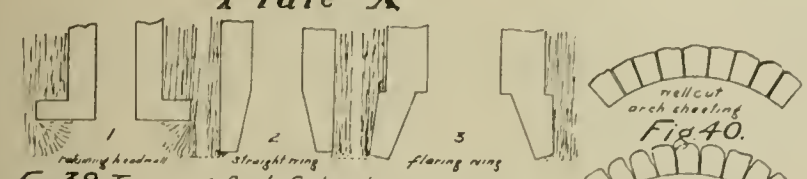


Fig39. Types of Arch Culverts

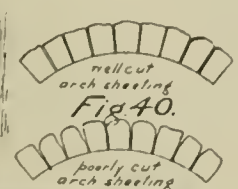


Fig40.

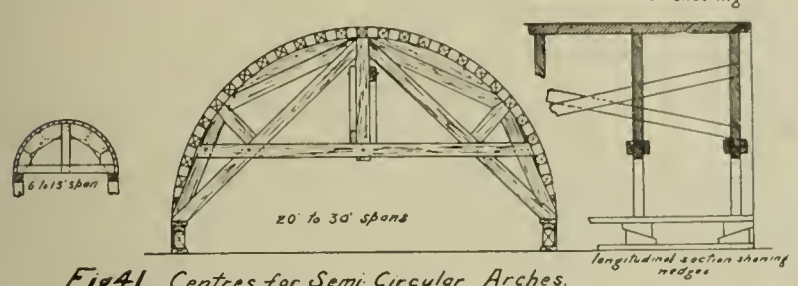


Fig41. Centres for Semi Circular Arches.

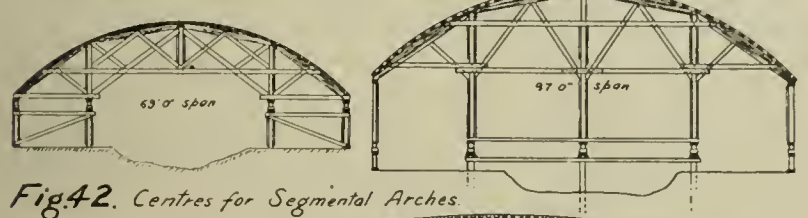


Fig42. Centres for Segmental Arches.

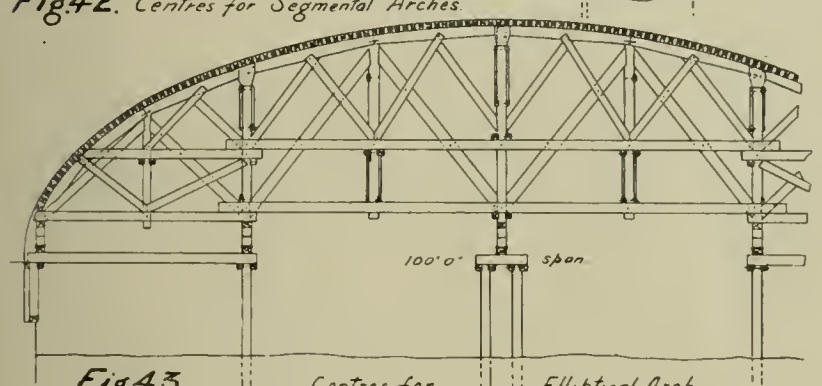


Fig43. Centres for Elliptical Arch.

the curvature, when the outer ring is one brick thickness behind the ring inside it, at which point a header is inserted; for a circular arch this is about once every 33° of arc and is independent of the span. Longitudinally both brick and stone arch sheeting should be well bonded also, and after the arch has been completed and the centres removed, a heavy coat of cement mortar (1 to 1) should be plastered over the back of the arch down over the haunches or spandrel filling so as to prevent percolation through the joints. In construction of the arch and spandrel masonry the two sides should be carried up at about equal rates, as a heavier load on one side will tend to push over the timber centres.

(*c*) Arch abutments need not be made of such an expensive class of masonry as that of the arch sheeting. A rock-faced ashlar about equal to second class bridge masonry is suitable, and in designing their dimensions due regard must be had to the character of the filling behind the abutments and the depth of filling over the crown.

There cannot be said to be any fixed law by which the dimensions can be determined. The various theories advanced disagree in vital points. Some take account of the horizontal thrusts tending to increase the stability of the abutments, and some do not; some attempt to allow for rolling loads, and others use only a uniform quiescent load. It may be said in general, that for small arches where there is a large margin of safety allowed, and under heavy banks where rolling loads have little effect, the dimensions as given by Trautwine are satisfactory, but where it is deemed necessary to construct a curve of pressures, Scheffler's theory of least crown thrust and neglecting horizontal forces errs on the side of safety and is easy of application; and in constructing curves of pressure taking the point of rupture as the critical point it will be noticed that these curves pass rapidly toward the back of the arch sheeting into the haunch filling before they reach the springing line, when a uniform depth of sheeting is used equal to the depth necessary at the keystone, or slightly greater; this makes it evident that there is no such thing as a semi-circular arch, but that a segment of about 120° (60° on each side of the vertical) is a true arch and the remainder is really a part of the abutment, and for this reason the spandrel (haunch filling) masonry should be carefully constructed near the springing line and of as good a class of masonry as the face walls; higher up, however, it may be of rubble masonry as its weight is its only function.

The foundations of arch abutments are a very important consideration, as a very slight settlement will derange the curve of the arch and endanger its stability. If the foundation bed is not found to be uniformly good after careful testing with an iron bar, the best way to distribute the pressure is to lay a foundation course of concrete, or

Plate XI

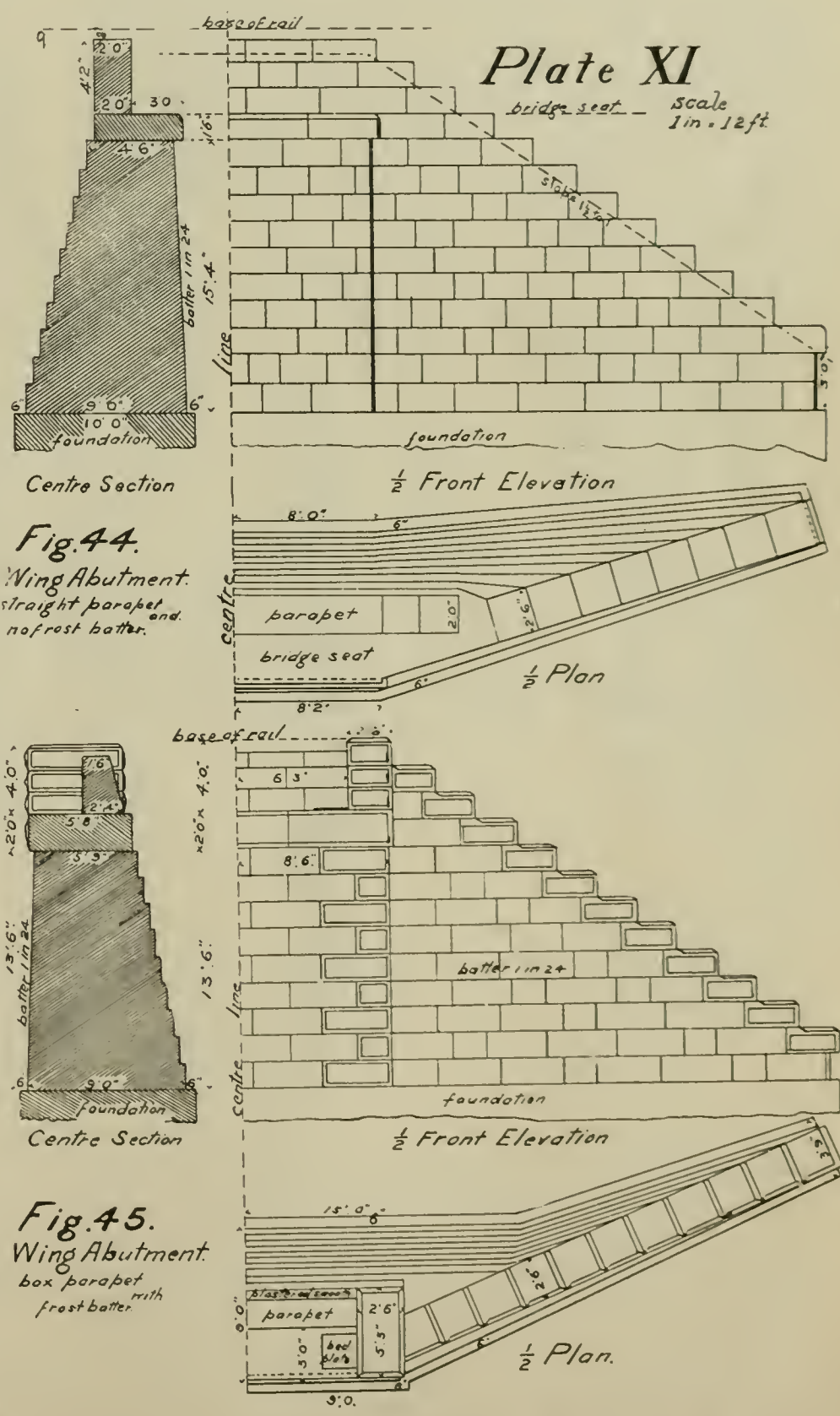


Fig.44. Wing Abutment. Straight parapet and no frost batter.

Fig.45. Wing Abutment. box parapet with frost batter.

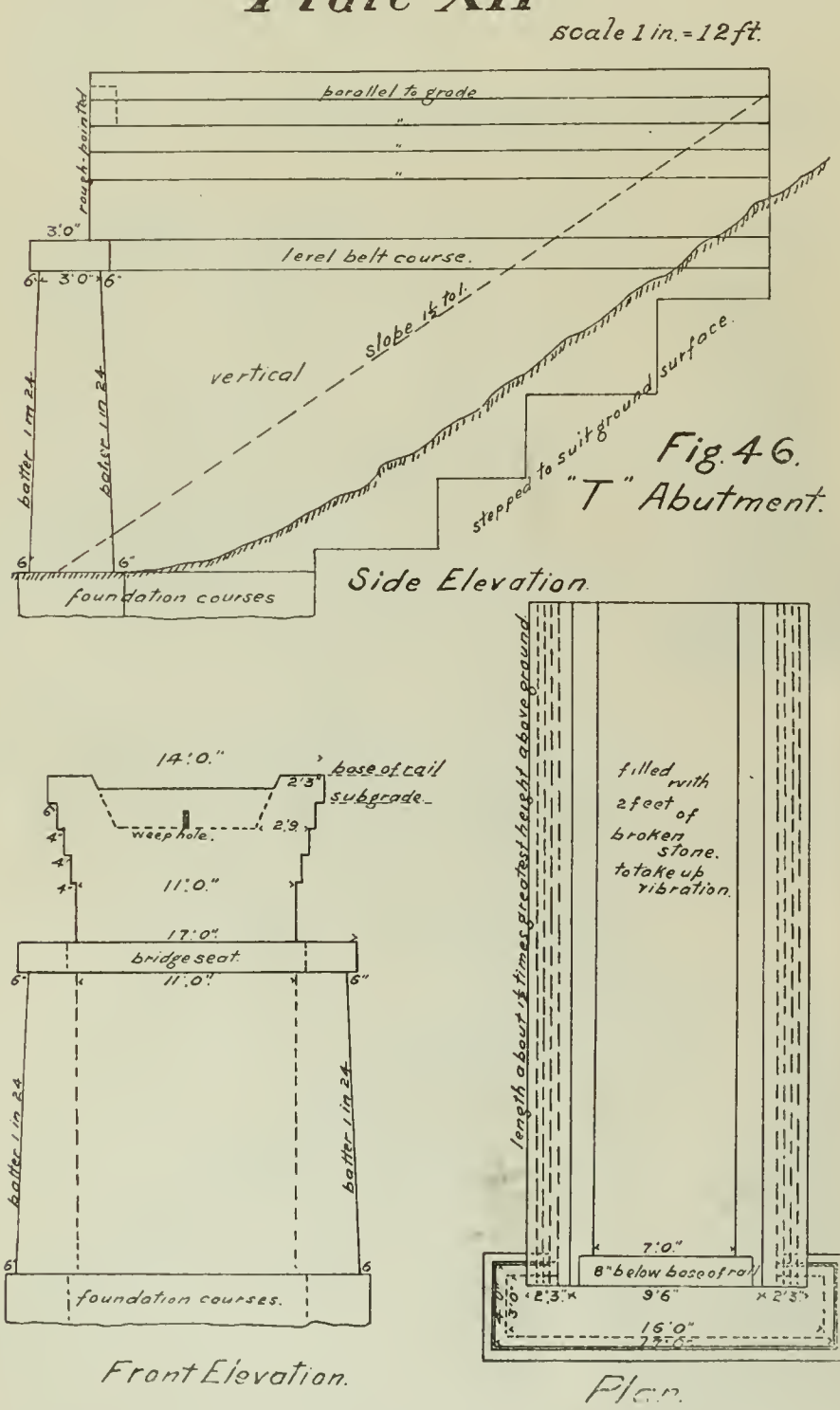
piles and concrete, if the bearing power of the soil is not found sufficient.

ARCH CENTRES.

To support the arch sheeting during construction and give the correct form to the arch a series of timber seg-

ments with an exterior covering of longitudinal strips or timbers is used, until the keystones are inserted. They should be designed for the weights they are to carry and rigidly supported so that absolutely no settlement may occur. But at the same time each point of support should be either on wedges that can be slackened, or on cylinders filled with sand that can be drawn off gradually at the proper time. Soon after the keystones have been inserted the easing process should begin and should be in two stages. First, a slight easement sufficient to bring each joint under pressure, and in a week or two later when the mortar has become hard they may be gradually and uniformly lowered so as to throw all the load on the arch. Figures 41, 42, 43 and 36 illustrate types of centres, and the wedges are shown in Fig. 41.

Specification for Stone Arch Culvert Masonry.—It will be laid in cement mortar of approved quality, the



arch sheeting stones shall be of the length, depth and thickness shown on the plans, or such as the engineer shall prescribe, and shall be cut accurately on their intrados, beds and joints according to template, and shall be carefully laid with a thoroughly good bond lengthwise of the arch. The face ring stones shall be left rough on the face, except a 1½ inch intrados draft, and no projection allowed of more than 3 inches from such draft. The spandrel filling shall be rough rubble similar to good box culvert masonry, but of good bed, bond and quality of stone. The abutments and wings, or head walls and parapet walls shall be either first-class or second-class bridge masonry as the engineer may direct. (See bridge masonry specifications.

The cost of arch culvert masonry will vary with the price of stone cutting, price of brick and labor, but may be taken ordinarily at $6 per cubic yard for rubble arches; $8 to $10 for second-class arch abutments; $10 to $14 for cut arch sheeting; $8 per cubic yard for ordinary brick arches.

The quantity of masonry in arches of even the same span and rise will be so entirely dependent on the height of abutments and depth of foundations that no table will be given. The tables given for purposes of approximate estimates in Trautwine "Engineer's Pocket Book," will be found very useful.

Article 20.—Arches.

So much has been written on this subject and the design of large arches for rivers or roadways, or for carrying roads over railways, etc., has received such elaborate study, that it is outside the range of this work, but types of such structures are given on Plate XI., and many of the remarks on arch culverts will apply to the larger structures with even greater emphasis, (*e.g.*), the importance of immovable foundations, and taking care of the line of pressures below the haunch and in the abutments, for this purpose the abutments are often built with the beds inclined to the horizontal and nearly at right angles to the pressure, see Fig. 36, and in any case should never be further from such a right angle than the angle of friction of stone on mortar.

Whether in a given case an arch or two abutments and a plate girder span will be preferable, depends on the depth of the bank and width of stream, as far as economy is concerned, but other considerations are the greater durability and safety of an arch, its finer appearance and an absence of repairs.

The use of concrete with steel rods or wire embedded in the tension side of the arch sheeting has lately come into use for arches of small rise, especially where rolling loads tend to distort the arch, the possibility of this form of construction lies in the fact that steel and concrete have almost identical co-efficients of expansion.

Article 21.—Bridge Substructures.

As the size of waterway increases, the cost of an arch soon becomes excessive, owing to the heavy abutments necessary for arches of long span and small height. On the other hand the cost of bridge abutments increases very rapidly with the depth of bank, so that we have two limiting features to guide us in the selection of the style of structure most suitable for a given small stream or creek, *e.g.*, with a 30-foot span and embankment 30 feet high the costs about equal each other. But whenever the arch does not cost appreciably more than the open span it should be selected, owing to the absence of floor repairs and to increased safety given. It must be remembered that the addition of a solid buckleplate floor and ballast to a plate girder will, however, make it practically safe and almost eliminate repairs.

When the stream to be crossed is of considerable magnitude the question of span lengths will be the first one to decide upon, which must be done with due regard to the probable life of iron work and the cost of replacing and painting it, as well as to the total present minimum cost of structure.

The approximate minimum cost of structure is obtained when the cost of the trusses, not including the floor system, is equal to the cost of the masonry, which should include the cost of foundations, etc., but exclude the cost of those portions of abutments of which the function is to retain the earthwork and not to support the bridge, *i.e.*, the wings, etc.; but it is usually safe to arrange the spans so that the

masonry will cost slightly less than the iron, because the estimate of the latter can be made quite accurately, whereas the actual expenditure incident to river masonry construction will usually be in excess of preliminary estimates unless made with great judgment, especially in deep rivers of uncertain bottoms.

ARTICLE 22.—BRIDGE ABUTMENTS.

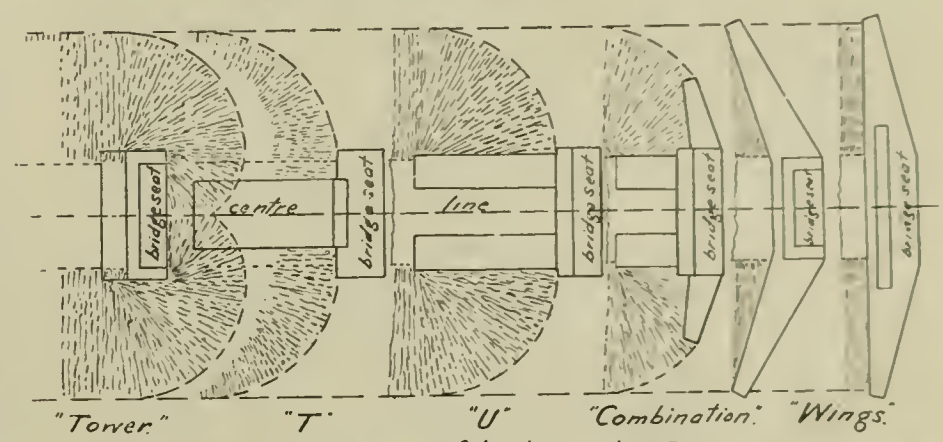
The most suitable design for an abutment will depend on the ground configuration, the position of the face of the abutment relatively to running water liable to scour, and to the amount of earth filling available—the various types in use are shown in Fig. 47. Of these, the tower abutment is always the cheapest, but can be used only when the embankment may be made all around it, on dry ground; the filling at the sides and front should be carefully made so as not to endanger its stability, practically it is used in two cases: First—Often as an abutment to an iron viaduct, with an adjacent heavy cutting and no stream to interfere with the foot of the slopes; and second, when a ravine is partly filled by a necessarily heavy cutting; but no borrow is convenient to complete the remainder, and an iron span must be used to bridge an insignificant stream.

The "T" abutment consists practically of a pier to carry the bridge span, and a masonry approach to carry the track onto the bridge. The objections to the "T" abutment are, that the masonry is damaged by vibration from the trains, and that the front cannot well be protected from river scour. The first objection is met by designing the stem of the "T" to be filled with two feet of rock ballast, to take up vibration; but the abutment must be kept well back from the bank of a stream liable to scour. The cost of a "T" abutment is less than any other (except the tower), when the conditions are favorable. These conditions are, that it is to carry a deck truss, and that the stem of the abutment is stepped into an ascending hillside, thereby lessening the quantity of masonry in it considerably. See Plate XII, Fig. 46. Essential advantages of this abutment are that it is practically in stable equilibrium from earth thrusts as the earth slopes run around the stem, and that water cannot lodge behind it. For through trusses needing wide piers, a "T" abutment is not especially economical, unless the saving on the hillside steps is considerable. The masonry for the pier should be first or second-class bridge masonry, but the interior of the stem may be of heavy rubble, with a cut facing, thus reducing the cost of the abutment to an average price of $8 to $10 per cubic yard.

The "U" abutment is similar to a "T," except that the stem is split into two parts and separated until considerable filling can be placed between the two parts. For deck spans up to 25 feet in height and through spans up to about 30 feet in height, the masonry in this abutment is less than in a "T" abutment, but above this height the quantities increase very rapidly owing to the increased lateral dimensions of the wings, which are designed as level retaining walls. The class of masonry necessary, however, is superior in the wings to that of the masonry in the stem of the "T" abutment, and the average cost of masonry will range from $1 to $2 per cubic yard more, or, say, $9 to $12 per cubic yard, so that it is very seldom less expensive to build than the "T" abutment, but it is very much used, owing to an impression that the wings are not affected by the train vibration. It must be kept well back from a scouring stream, and the toe of the slope in both of these classes of abutments should be protected by rip-rap, if there is any running water. Another serious objection to a "U" abutment is that it is liable to lodge water between the wings. This should always be provided for by weep holes. Whether this abutment is cheaper than a wing abutment will depend on the allowable slope of the earth, and also on the economy that can be effected by stepping the wings into the hillside, see Fig. 48. Some engineers economize masonry in the stems of "T" and wings of "U" abutments by introducing semi-circular arches of 10 ft. to 20 ft. span, just back of the pier-portion of the abutments

The wing abutment is usually used where the ground is level behind the abutment, and where the face is close to running water liable to scour, in which case the wings are flared back about 30° so as to prevent any contraction of the waterway. This abutment presents a neat appearance, and the backing may be made of rubble masonry, thus reducing the cost of the whole to about the price of "T"

Plate XIII



Bridge Abutment Types. Fig. 47

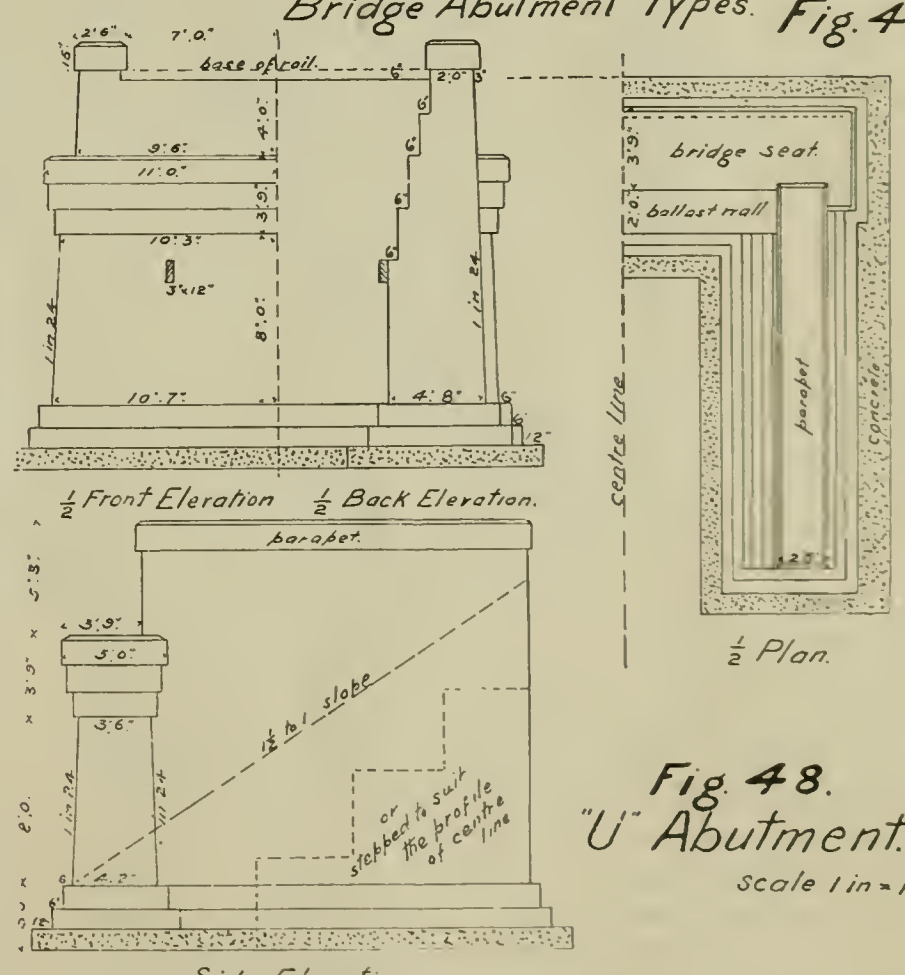


Fig. 48. "U" Abutment. scale 1 in = 12 ft

abutment masonry, *i.e.*, $8 to $10 per cubic yard, but it has several objectionable features: if the foundation below footings is deep, to good bottom, the quantity of masonry in the foundation is excessive. See table XV. (C). And also, its design as a level retaining wall is always a question of more or less doubt. The ordinary rule of the width at base, being $\frac{4}{10}$ of the height + the front batter, is satisfactory if the filling behind is of average quality, but if made of heavy wet slippery clay, the structure may be in danger. Again, in designing the foundation it is necessary to know that it will always receive support in front or else the rule of $\frac{4}{10}$ must be carried down to the foundation bed. For these reasons, an abutment with a straight back and only a tapering to the wings is preferable to one with

wings flared back, as it does not hold water behind it so readily and is not under so severe a strain tending to crack the wings from the body of the abutment. To increase the stability of a wing abutment the foundation pit in front should be always rammed solid with clay, or preferably concrete, up to the ground level, and in cold climates a frost batter given to the back of the parapet wall. See Fig. 45. This prevents the frost from dislodging it.

There is a great diversity of opinion regarding the correct cross-section of retaining walls in general, and in applying any rule or formula the utmost caution is necessary, because each design is a problem in itself; items to be considered are: the material to be used for backing, the manner of placing it, the slope of the natural ground behind and in front of the abutment, the drainage of the area behind the abutment, the kind of masonry and mortar to be used, etc. So many complexities would thus be given to any theoretical formula that in such designs it is, in most cases, best to be guided by past successes and failures in structures that have been similarly situated. The actual design of an abutment is very simple, the depth from base of rail to bridge seat, and the length of truss will be given, and also the distance apart of the trusses, centre to centre. Thus, deck trusses will need a bridge seat about 16 feet long and $3\frac{1}{2}$ to $4\frac{1}{2}$ feet wide, while through spans require bridge seats 22 to 25 feet long and 4 to 5 feet deep. The approximate quantities of masonry for different styles of abutments as given in table XV. and plotted in diagrams, will be understood as extending to a uniform foundation level, the quantity saved in "T" and "U" abutments by stepping into the hillside must be deducted, and the quantity in foundation courses added, both of which will be so much less favorable for wing abutments in any comparison involving deep foundations or steep hillsides.

TABLE XV.

APPROXIMATE QUANTITIES OF MASONRY IN ABUTMENTS.

(A.)

FOR DECK PLATE GIRDER SPANS, BRIDGE SEATS 16 FEET WIDE, CALCULATED FROM DESIGNS GIVEN IN FIGS. 44, 46, 48.

Not including footing courses.

Style of abutment.	Depth from base of rail to top of footings. 10′ c. yds.	15′ c. yds	20′ c. yds.	25′ c. yds.	30′ c. yds.	35′ c. yds.	40′ c. yds.
Straight wing abutment..	38	80	151	257	402	596	841
"T" abutment, earth slopes, 1½ to 1...	45	120	227	366	538	742	979
"T" " " " 1 to 1...	27	77	150	244	361	500	661
"U" " " " 1½ to 1...	43	101	210	358	582	858	1,195
"U" " " " 1 to 1...	31	71	144	243	391	575	800
Tower " thickness 50 per cent. of height	27	49	79	119	166	222	285

(B.)

FOR THROUGH SPANS, BRIDGE SEATS 22 FEET WIDE, CALCULATED FROM BAKER'S "MASONRY CONSTRUCTION."

Not including footing courses.

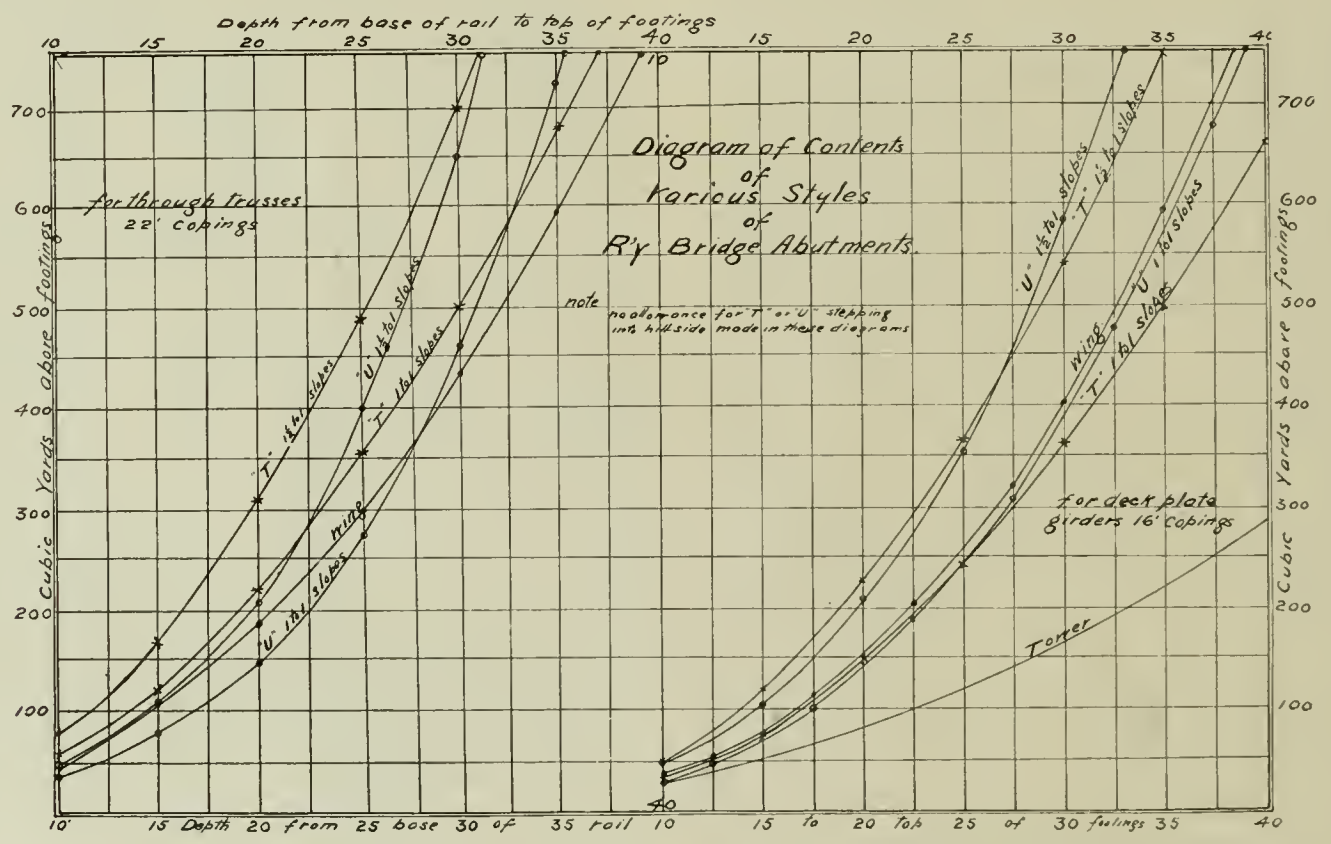
Style of abutment.	Depth from base of rail to top of footings. 10′ c. yds.	15′ c. yds.	20′ c. yds.	25 c. yds.	30′ c. yds.	35′ c. yds.	40′ c yds.
Wing abutment	44	104	186	294	426	588	781
"T" abutment, earth slopes, 1½ to 1	78	169	309	481	696	...	...
"T" " " 1 to 1	56	120	219	346	494	676	879
"U" " " 1½ to 1	47	107	206	386	650	...	...
"U" " " 1 to 1	36	80	149	271	452	712	1,025

(C.)

AREA OF FIRST FOOTING COURSE FOR FOUNDATIONS OF ABUTMENTS AS ABOVE IN SECTION (A.), ALLOWING 6" PROJECTION ALL AROUND.

Style of abutment.	Depth from base of rail to top of footings. 10′ sq. ft.	15′ sq. ft.	20′ sq. ft.	25′ sq. ft.	30′ sq. ft.	35′ sq. ft.	40′ sq. ft.
Straight Wing Abutment	265	384	569	797	1,047	1,330	1,673
"T" abutment slopes 1½ to 1	202	299	400	499	599	700	801
"T" " " 1 to 1.....	142	209	280	349	419	489	559
"U" " " 1½ to 1.....	193	311	477	670	917	1,076	1,250
"U" " " 1 to 1	129	213	323	458	614	724	806
Tower "	114	149	196	243	290	337	384

—Pressure on our columns has obliged us to hold over a number of interesting articles till next issue. Among them is a description of the new silver-lead mines in the Ottawa valley, and the further discussion of the Toronto city hall question.



DISPOSAL OF TOWN'S REFUSE.

BY W. M. WATSON.

(Continued from last issue.)

A report just come to hand from London, Eng., on the work of one city commissioner, states that at Lett's wharf, where the dust and refuses are carted, the following articles of value were found among the garbage during the twelve months ending September 1st last, viz., cheques for £40, £23 13s., £31 16s., £42 14s. and £3; a dividend warrant for £27; a demand note for £1,000; a promissory note for £706, which were returned to the owners and reasonable rewards received, together with a good deal of money, gold rings, watches and other valuables. From the small section of London that use Lett's wharf they received besides the above, for old paper, £541 17s.; old rags, £47 10s.; bottles, £84 16s.; string, £181 3s. and books, £24. The old metals are not given in the report, so that there is more to be got out of the public refuse than many suppose.

Furnaces very similar to what is described in part can be seen working at Deseronto, Ont., only the fire boxes are not so large, because they are regularly fed by a long chute direct from the saws and carried along by a

carrier chain that feeds each boiler, keeping the fire box always full up to the top. Shoreditch, in England, compares well with many towns in Canada, inasmuch that a large quantity of the refuse that they destroy is shavings and sawdust from their staple industry of cabinet-making; that throws a large quantity of heat which is taken advantage of by that small town to supply themselves with electric light, and it is stated to be a genuine success. To add to this, they have the income from the sale of metals and other things of value sorted out of the garbage. We are told that seven towns that have visited Shoreditch by deputation are intending copying their method.

The increase during the past few years in the units of heat extracted from coal, and the fact that it is possible to convert refuse into fuel, is largely due to the improved arrangements in building flues, the design of furnaces, and adding a combustion chamber to mix and re-burn the gases and smoke that are cast off by the fires. This not only largely increases the units of heat, but also the temperature is increased, due to the introduction of combined air and steam blowers, which give a strong blast, as well as moisture, to the fire, so that the combustion of the fuel used is increased and the waste products lessened, and clinkers are prevented from adhering to the fire bars. The leading blower of this class was invented by a Canadian named Earl. It is composed of a bunch of fine steam jets that blow downward through a large taper pipe acting as an injector, bending at floor line, and passing horizontally through the brick wall into the ash pit, which has air-tight doors; behind the steam jets a pipe made from sheet iron is conveyed to above the crown of the boiler, so that when the steam jets are set in motion they draw a swift current of warm air down, which mixes with the steam, enters the ash pit, and passes up through the fire bars, coming in contact with the body of fire at the under side. The success of the refuse destructor patented by the Horsfall syndicate is due to a combined steam and air blower, similar to Earl's. Another of the kind, patented about the same period by Meldrums, has only one steam jet fixed near the end of a taper 3-inch pipe through which a strong current of air is drawn in when the steam jet is working. The combined apparatus is so small and compact that it can be easily attached to a Lancashire boiler.

I take it to be more economical to assist combustion and to increase the temperature of a furnace by blowers acting directly on the fire than it is to draw up the fire by using a long chimney, because when draughts are created by chimneys the force is at the terminating end of the heating surface, similar to a locomotive, which has its blower in the mouth of the smoke stack. By using a chimney to increase the temperature of the furnace, the hot gases are partly drawn away from the surface of the heating plates and tubes, the object of the passing heat being to get to the chimney shaft as quickly as convenient, where in most cases the hot gases arrive before they have sufficiently exhausted their heat on the heating surface of the boiler. Proof of this is established whenever a chimney is burnt out, which is often the case at the root, plainly pointing out that thousands of dollars' worth of fuel has been wasted.

While in England last year, I was shown a boiler furnace built a few yards away from where the boiler was set up on the Siemens system—the system by which steam is raised from towns' refuses, compelling the fiery gases to travel and increase their temperature before they reach the place of work. This one had proved a failure and a fuel eater, but not from any fault of the system, but from the ignorance of the designer and bricksetter. The space between the fire-box and the front of the b iler, which should have been a combustion chamber to mix and reburn the gases, was simply a large straight open space, too much for the fire to make and keep red hot, so that the gases leaving the fire made a bee line through the culvert or large flue, decreasing, in place of increasing, the temperature of the gases. The furnace should have been in two divisions, so that when one received the green coal the other would be white hot, and the gases both entering one flue, the gas coming from one with the highest temperature would take up the gases and smoke from the green coal of the other furnace and burn it, so that they both would gain the high temperature required. To enable them to do this the flue should have been somewhat smaller, so that the brickwork would be permanently as hot, if not even hotter than the fire, and have a series of fret work or bridges that would split up the gases dividing them so as to be prepared to be taken hold of by the white heated brickwork of the combustion chamber and super-heat the gases, giving them probably about double the units of heating power that they had when they left the fire bridge.

I have dwelt on this heating question because my experience in Canada is that some public works are spoiled in the minor details, or badly and ignorantly managed, which wastes a pile of public funds. For example, what a large amount of fuel and labor is wasted in the Toronto cremators that are a bill of expense and of small use, because the fumes of the foul garbage is often sent up the chimney to contaminate the atmosphere that ought to have been purified by being re-burnt in a combustion chamber when the incinerators are newly charged. To get a good practical lesson on the capabilities of refuse destructors the inquirer should visit Hamburg, Edinburgh, Shoreditch, and Bradford, where the handling of towns' refuses is performed on business principles, with the object of improving the health of the inhabitants and easing their expenses.

In this country we have many miles of land covered with sawdust and other saw-mill refuse, tannery refuse and similar combustible material that is rotting and throwing off injurious gases, creating an unhealthy atmosphere, that could be turned to profit and made to supply the nearest town or village with light and heat, or to turn the machinery for some manufactories. It is said that tannery refuse contains many units of heat, and by using a light steam and air blower it can be burnt easily, yet I saw a few weeks since three steam boilers fired with bought fuel within a few yards of a small mountain of spent tan bark that is an eyesore and a nuisance in the neighborhood. Besides all this, owners actually go to considerable expense in erecting plants to cremate the refuse from their saw-mills, which looks like wilful waste at the present time when heat and power can be transmitted many miles to places where there is a demand for it. It would almost appear that many of our people overlook these facts like the late John Stuart Mill, who made the remarkable speech in the British Parliament with the object of warning the nation against the reckless use of their coal, pointing out that the supply was limited, and that Britain's greatness partly depended on her coal. It had never crossed his mind that the sea and other waters could be made to give fuel and heat, and that the repulsive dirt and garbage swept up and collected in towns can be made to act as coal fuel, and give out as many units of heat per pound as coal was made to give in England forty years ago, and they are yet a long way behind us in England, because they blacken the air with the smoke from their boiler fires which ought to be used to assist in heating.

There is another waste in cities and towns ; where coal is used, we notice the commissioners' carts tip ashes that contain a large quantity of good fuel. Take a load of ashes, sift it with a quarter-inch riddle, place the residue in water for about a quarter of an hour, sift it again, and sort out the clinkers and other unburnable material ; then you will find that there is about half the load, clean washed carbon, that will burn as easily and give nearly as many units of heat as small pea coal. It is too bad to throw such carbon away, when many persons need more heat, and we depend upon the United States for our supply of coal.

Persons should never expect a brick setter, except he has been specially trained, to be able to build flues that will stand the heat, or turn the corners and the bends properly in a way that the heat will strike and hug the right places where it is most needed. I had a large boiler set in brick by what I thought, and was assured, was a trustworthy boiler setter ; but the apparatus would not heat, and on examination it proved that he had turned the bends of the flues in a way that the heat struck the bricks and not the boiler plates, and when the error was corrected the boiler heated thoroughly. Last year I spent a half hour looking through the mica window that showed the interior of the general combustion and heat collection chamber, surrounded in a circle with about 20 refusefurnaces, atHammerton street, Bradford, England. Each furnace had a separate combustion chamber for the reburning of its own fumes and gases ; from each of the twenty combustion chambers the gases passed into the large collecting and combustion chamber, which appeared to be about 20 yards long, 5 yards wide, and 3 yards high. The outlet of each flue leading from the small combustion chamber of each furnace entered the large one near the crown, and the gases of each could be plainly seen as they entered. There was more variety in the color of the gases than there is in the rainbow. The exact state of each fire could be known by the color of the gas the furnace was discharging. If it was a dark red it showed that the furnace was newly charged and the gases from it, even after passing the white hot brickwork of its own combustion chamber, were of too low temperature, and that the fumes coming off the burning night soil and ashes were not properly consumed, and that if such low temperature gases were allowed to pass up the chimney, they would poison the atmosphere.

Only one furnace was charged at a time, so that the other 19 were in a state of white heat, or approaching that point, so that when the low temperature gases from the new-fired furnace entered the general collecting chamber the higher temperature gases from the other 19 furnaces mixed with it, picked it up, re-burnt it, or we might say superheated it, thoroughly destroying the poisonous fumes it contained when entering the chamber before it could enter the long carrying flues to be used to raise steam by passing under and through the heating tubes of the boilers. In this second general collecting and combustion chamber lies the secret of the general success of the refuse destructor and the purity of the gases discharged from the destructor chimneys.

I have now given examples and detailed explanations to prove that the very best and most useful inventions can be made worthless and expensive by ignorance displayed in construction and management— that those towns which really desire to improve the health of the inhabitants and reduce taxation, by adopting methods invented by gifted, thinking men, may easily do so by securing the best and most experienced managers obtainable in the labor market, and do public business on the same lines as well managed private firms do theirs.

When the Hon. Joseph Chamberlain became the head of the municipal affairs of the great city of Birmingham, England, he quickly brought the public business from a state of chaos to reasonable efficiency. Such a head in Toronto might be worth at the present time about forty thousand dollars a year to the public. When Mr. Chamberlain was lately presented with the freedom of that well governed city of Glasgow, he stated in his speech that when corporations undertake such business as is now conducted by the great municipalities of England and Scotland, that their officials, the men who are entrusted with the management of departments, must be men of special capacity, special ability, or else there will be indifferent administration and great waste of public money. Canada would be quickly a great nation if it could import a dozen such men to act as controllers, and prevent public funds being spent on worthless appliances and excursion trips of men who pretend to take notes of machinery and works that they do not technically understand themselves, and often could not possibly give a valid reason for the statements made in their reports.

(To be continued).

THE LIFE OF GOLD MINES.

Now that many people are beginning to look on gold mining as one of the chief industries of Canada, more interest is taken in all details of mining processes than formerly. One of the most interesting parts of the subject is that touching upon the probable life of mines, because this is a factor of the greatest consequence to the operator of the mine, as it affects his profits directly, and is also a factor in the permanent development of the country. If we are to have a rush of miners to the Klondyke, attracted by the placer diggings, we shall reap only a temporary advantage; but if a great industry can be built up there in regular quartz mining, as Wm. Ogilvie the explorer of the country believes, and to that can be added coal and copper mining as well, the permanent character of such workings becomes of paramount interest. Extending at short intervals from Nova Scotia in the southeast to the Yukon in the far Northwest, Canada has a stretch of gold-bearing lands which are approached by those of no other country in the world. If these mines prove to be even ordinarily rich, the amount they will contribute to the wealth of the country is incalculable.

The gold mines of the Rand in South Africa are, perhaps, the scene of the most scientific mining which is being done in the world to-day, and the results of investigations made by the Rand mines are valuable aids to an estimate of possible conditions in Canadian mining, though of course the cases are, at best, remotely parallel.

The economic value of the main reef (Witwatersrand) was the subject of a paper by W. F. Wilkinson, read before the Chemical and Metallurgical Society of South Africa recently. The author discussed, among a number of subjects, that of the life of the mines in the main reef of the Rand, 27½ miles in length. The data which he assumes are very interesting, as showing, among other things, the best scale upon which mining operations in South Africa are conducted. The assumptions are: Depth of mining, 5,000 feet vertical ; length of reef on dip, 10,000 feet, on a basis of the Bezuidenville and Rand Victoria's borehole sections ; one ton—12 cubic feet ; average thickness of reef milled, allowing for waste, 4 feet.

Approximate outcrop distance in feet is	145,750
Million tons to 5,000 feet vertical	486
Estimated value per ton, in shillings (yield)	36 8
Gross value in million pounds sterling	892
Profits with working costs at 25s. per ton in millions of pounds	286
Profits with working costs at 20s. per ton in millions of pounds	406

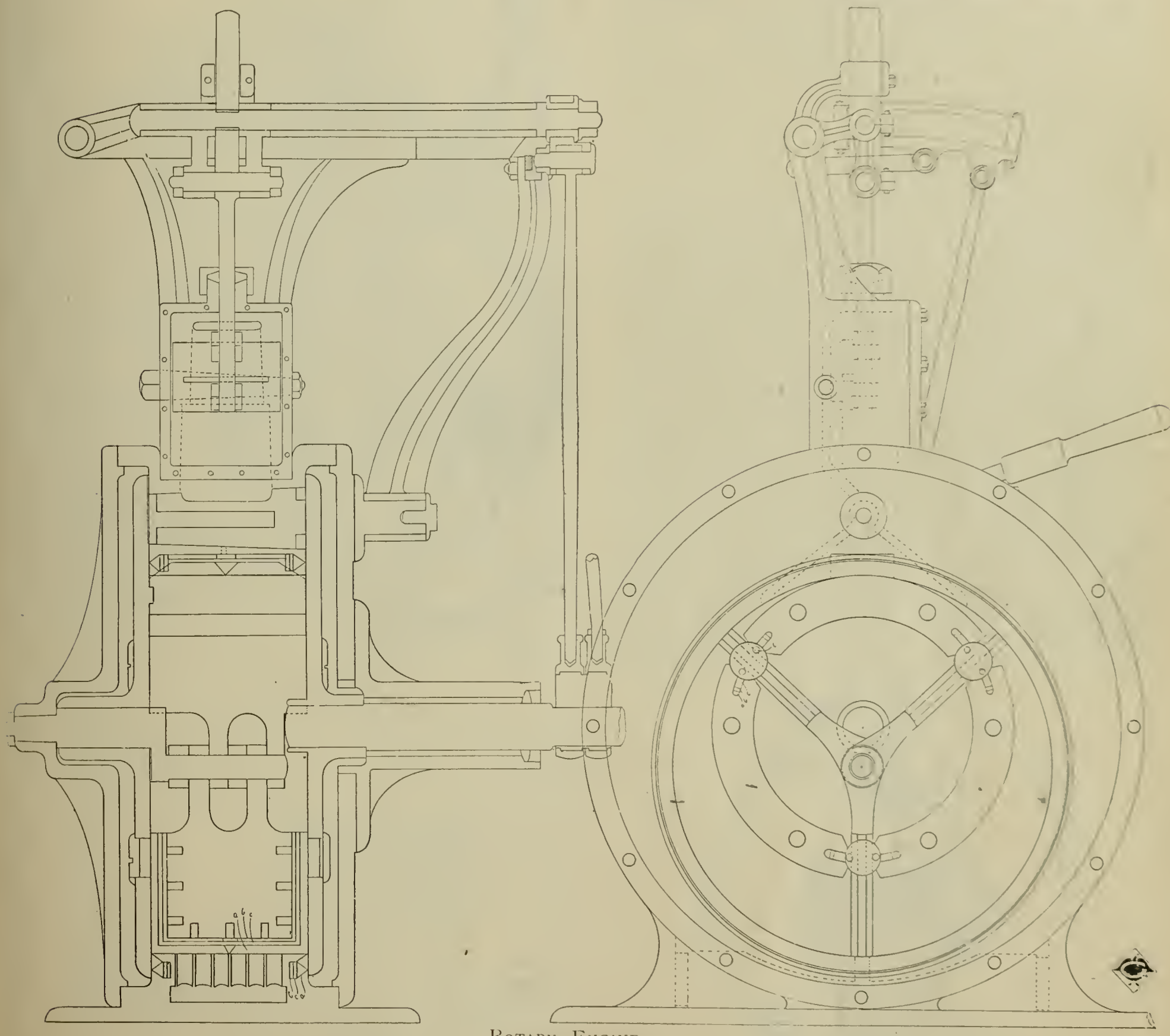
The result of this estimate shows that for this part of the Witwatersrand alone a tonnage of 486 (mills) having gold contents of £892,000,000, is available for mining. From these figures the amounts already won must be deducted. It may be useful for reference if similar estimates are given, which have been made from time to time :—

	Year.	Greatest vertical depth. Feet.	Million pounds.	Miles of outcrop.
Hamilton Smith	1893	3,000-3,500	325	11½
Schmeisser	1893	3,900	350	11½
Hatch and Hammond	1895	5,000	592	27
Becker	1896	5,000	700	20
Hays Hammond	1895	5,000	9 per 1 mile outcrop 1,000 feet depth.	

At the present time (1897) the tonnage milled from the Witwatersrand and district is between four and five million tons a year. Making allowance for the deep-level mines, and assuming that double this amount is removed, we get a life of, roughly, half a century. "This I consider," Mr. Williams concluded, "the very least period that the Rand mining industry will be of first-rate importance."

ROTARY ENGINE OF CANADIAN DESIGN.

The origin of the steam engine is now known to belong to a period before history began to record anything but mere political events. Hero of Alexandria produced a manuscript, 120 B.C., in which he describes a number of primitive forms of water and heat engines, and among the latter, that shown in the illustration on next page. This consisted of a globe held between trunnions, the steam entering from the boiler below through one of these. The



Rotary Engine.

rotary motion is produced by the reaction of the steam, which escapes from the bent arms. It is supposed by some that this contrivance was actually used by the Greek priests to produce motion in other apparatus. The next rotary engine is probably the model constructed by Denys Papin, in 1690, for working pumps and driving paddle wheels. This consisted of a cylinder and a piston, which was raised by steam pressure, its descent being permitted by the vacuum produced by the condensation of the steam.

Every engineer is aware of the loss of power insep-

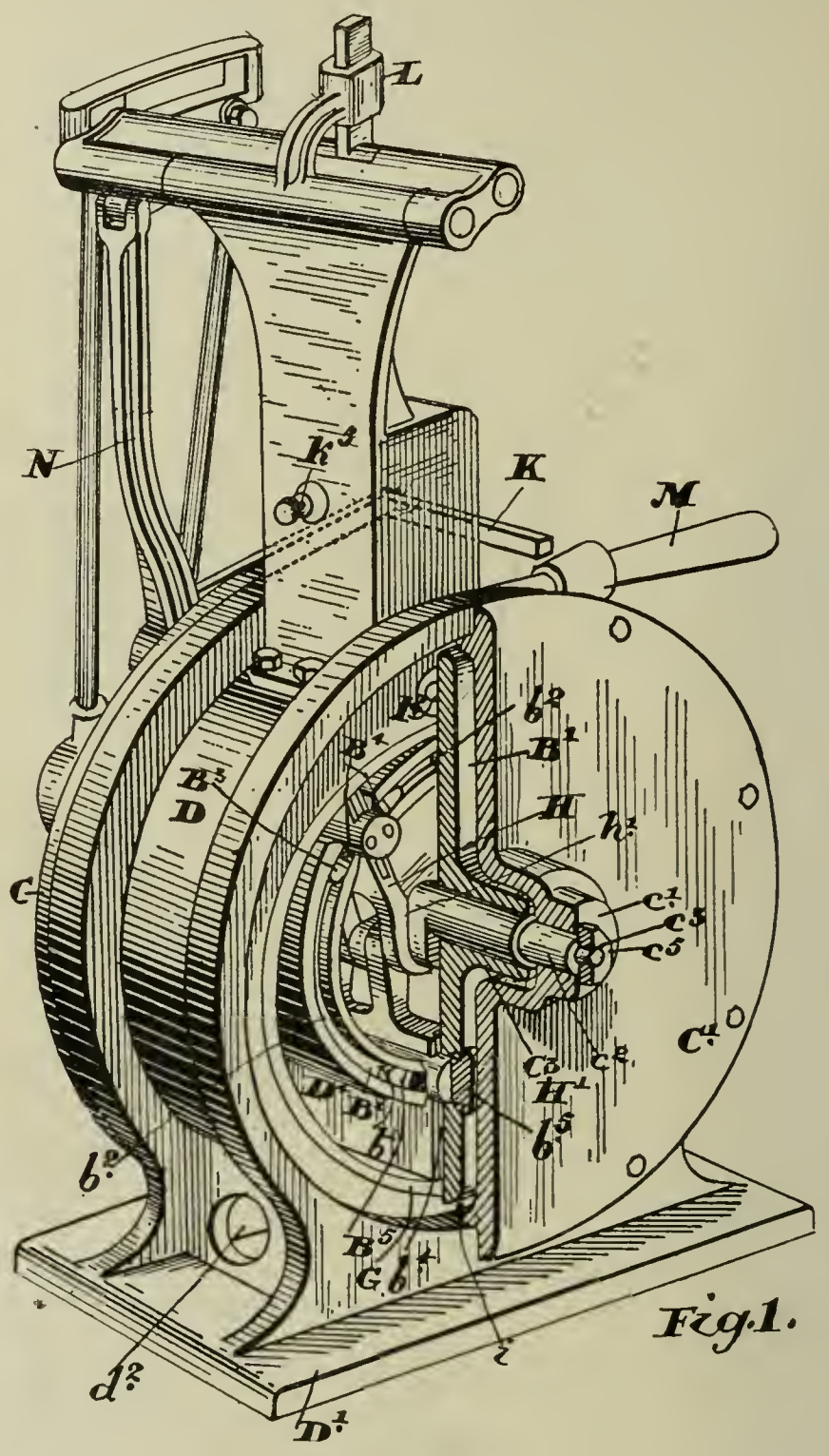
arable from the movements of all types of engines now in common use, and most engineers are familiar with the almost innumerable attempts made to get the rotary principle into practical use. So far the enormous consumption of steam has been the point at which all inventors have stuck, and most inventors of rotary engines have encountered further difficulties in designing an engine with parts that will not grind, and yet are steam tight.

In advance of a scientific test we are not prepared to say that the type of engine we are about to describe surmounts all these difficulties, but a representative of THE CANADIAN ENGINEER visited the works of Messrs. Baird & Tree, at Woodstock recently, and saw a rotary engine that had been in daily use over six months, and when taken apart the internal parts that would be most subject to wear still show the marks of the hand scrapers. This would seem to settle the question of steam-tight chests with absence of grinding. As to the consumption of steam, the inventors and designers of this engine have an ordinary old upright boiler, such as is used on threshing machines, and their consumption of fuel is one and a half cords per week of beech and maple cordwood, running 13½ hours per day. The engine operated by this boiler has a cylinder of 4 inches face and 8¼ inches inside diameter, the ring piston taking up 6¼ inches of that. Out of this they estimate that they get eighteen horse-power with steam pressure of one hundred pounds, engine running at nine hundred revolutions per minute. They at first used a four-inch rubber belt, but had to change it for a six inch belt and have been operating the following machinery running from two lines of shafts, besides counter shafting: one engine lathe of four feet swing over shears and eighteen feet bed, one engine lathe of twenty-two inch swing and ten feet bed, one engine lathe sixteen inch swing and eight feet bed, one shaper sixteen by twenty-eight inches, one drill press thirty inches, one drill press twenty inches, one set emery wheels; these, we understand, have been all in operation at one time on fifty pounds steam, running at 400 revolutions. This engine is mounted on a light wooden box, and has been run at between 1,400 and 1,500 revolutions per minute with little

HERO'S ROTARY ENGINE.

vibration. Our readers will, no doubt, be interested in the forthcoming test of the large new engine of this time, which will take place, we understand, at McGill University, Montreal. Messrs. Tree, Baird and Eldon, the inventors, designers and promoters are all young Canadians.

Fig. 1 shows the external appearance of the engine, with one-half of each of the two circular casings on one side removed, so as to exhibit the inner mechanism. *D* is a hollow cylinder attached to a bed plate D^1; the hollow of the cylinder is not placed centrally in *D*, being dropped down a little, and thus the main shaft does *not* enter at the centre of this hollow. *D* is cored out so as to



ROTARY ENGINE.

leave a flange on each end or side, and to these flanges are bolted two circular casings *C* and C^1, which enclose the two open ends of the cylinder *D*. Into the cylinder *D* is placed the ring piston B^1 (see Fig. 2 and outline), which is a smaller hollow cylinder placed eccentric to the larger one, and in contact with it at the top, thus leaving a crescent-shaped chamber D^4, in which the steam acts. The ends of the ring piston are enclosed by circular casings or discs *B* and B^2 (see Fig. 3), which extend beyond its periphery so as to have a bearing on the larger cylinder *D* just inside of the outer casings *C* and C^1, and thus enclose the crescent-shaped chamber which is made perfectly steam tight by means of automatic adjustable packing. The casings *C* and C^1 of course are stationary, but casings *B* and B^2 revolve with the ring piston on the main shaft, to which they are attached solidly; the ring piston and casing *B* are one piece, the casing B^2 being bolted to the ring piston, and all three are solidly attached to the main shaft *A* (Fig. 3). The main shaft is propelled by means of three wings *H*, *H*, *H* (see Fig. 2) which act on the ring piston.

Figs. 2 and 3 are vertical sections of the engine, the one at right angles to the main shaft and the other parallel to it. They show the relation of the ring piston, the wings, the shafts, etc. In the ring piston B^1 are three slots equi

distant from each other, and in each slot is placed a bronze swivel H^1 (see Fig 4) with an opening h through which

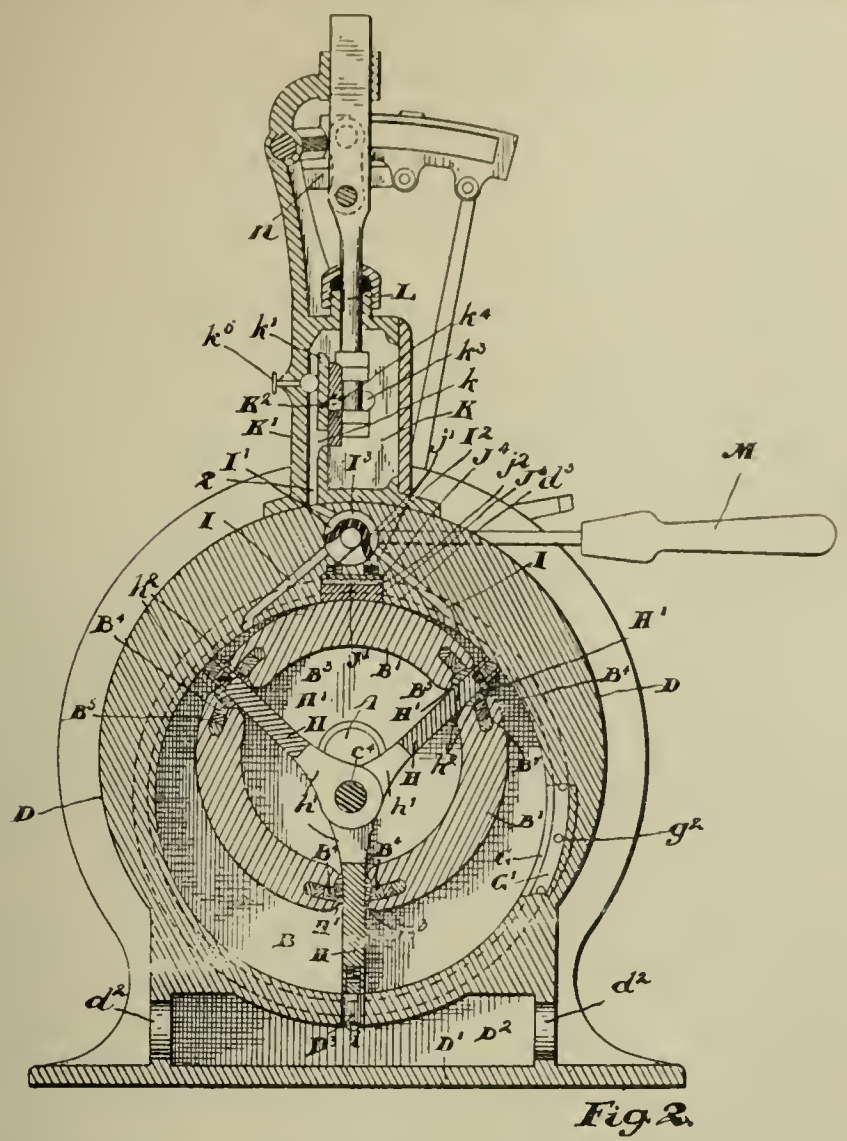


Fig. 2.

the wings slide. Now it will be seen that the main shaft A (see Fig. 3 and outline also) passes through the outer casing C, is solidly attached to the inner casing B, and acts at the centre of the ring piston, projecting into it a very short distance only; also that the outer casing C provides a journal for the shaft. The shaft on which the wings H, H, H rotate is stationary; it is solidly attached to the outer casing C^1 at c^2 on the side opposite to the main shaft; it then becomes a shaft on which the revolving casing B^2 is journalled at C^3; on entering the ring piston hollow it has an offset C^4 and becomes the wing shaft at c^4, acting at the centre of the hollow of the cylinder D, through which the wings sweep.

Fig. 4 shows a section of the ring piston, a slot, a swivel H^1, an opening h for the wings, and the automatic adjustable packing.

Fig. 2 and the outline, or working drawing, also show

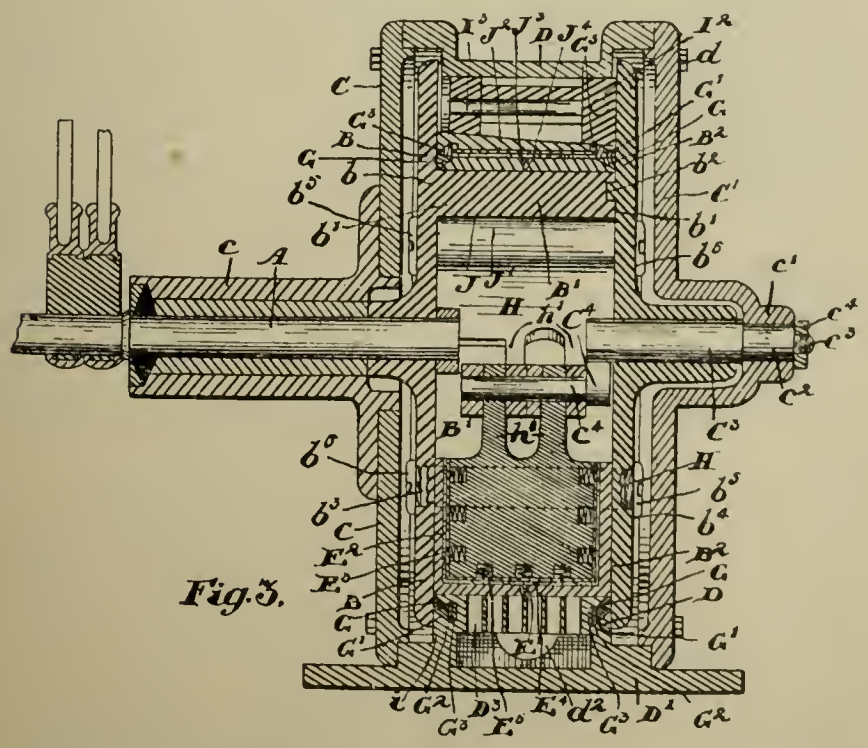


Fig. 3.

the course and the action of the steam. The steam chest K is set in between the flanges of D. The slide valve is worked by means of a link motion connected with the main shaft by an eccentric shaft (see also Fig. 1). By a novel device the lever M, for reversing the engine, connects with the link motion, and at one stroke reverses the engine. The live steam passes from the steam chest to the reversing plug and onward through a short channel I, entering the crescent-shaped chamber at the port. Notice again that the ring piston is attached to the main shaft, and that the wings rotate on a stationary shaft attached to the side opposite to the main

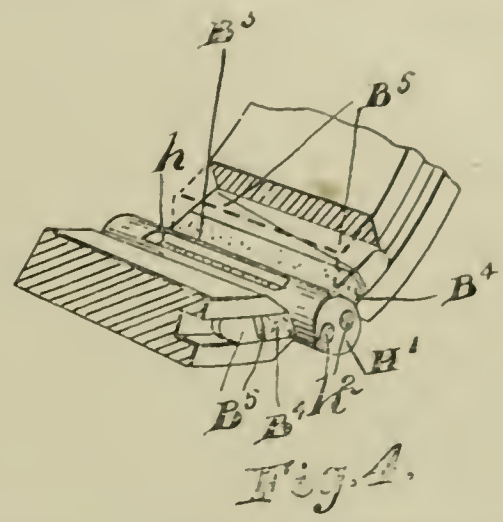


Fig. 4.

shaft, and thus the action of the wings in propelling the ring piston. Now the live steam, entering the port at the narrow part of the crescent, acts on a wing until cut off by the valve, and then expansion acts in the larger part of the crescent until the wing reaches the exhaust port at D^3. As soon as exhaust commences, live steam begins to act on the next wing, the power of the live steam increasing as that of expansion decreases, which gives a constant and a continuous pressure. The slide valve is so arranged that steam may be cut off at any stage, and thus allow live steam to be economized and expansion to be utilized to almost any extent; one up and down stroke of the valve allows steam to act on the three wings in succession. Not only does live steam act in the small part of the chamber and expansion in the large part, and both in treble succession, but as the expanding steam grows weaker its leverage on the wing becomes greater as the wing moves to the port D^3, and thus a further use of expansion. Again, instead of a back pressure at the time of exhaust, there is a forward pressure, for when

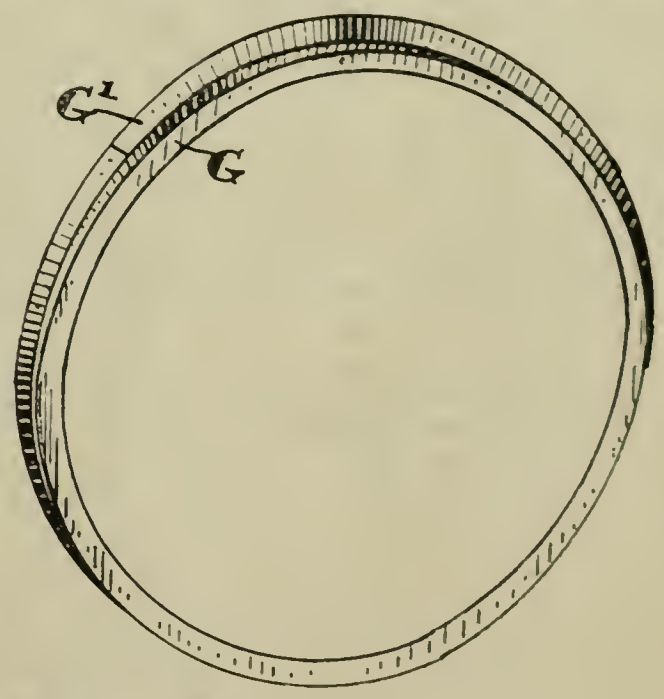


Fig. 5.

the wing passes the exhaust port at D^3, there is a pressure against the wing receding from D^3 as also against the one advancing to this port; but the steam surface of the receding wing is greater than that of the advancing wing, and thus a resultant forward pressure. The port opposite to the one used as an intake is used as a supplementary exhaust for any trifle of steam that may not exhaust at D^3.

Friction in this engine is reduced to a minimum, and perfect steam tightness is secured by means of its revolving casings and novel system of packing. The crescent-shaped chamber is enclosed by the revolving casings B and B^2; these casings do not bear on the face of the cylinder D, although so close that they almost touch it; Fig. 5 shows a couple of V-shaped packing rings which are placed in a groove G^1 (Fig. 2) and which with springs g^2 act automatically in producing steam tightness between the revolving casings and the face of D, and also in reducing friction to the minimum quantity. Again, where the ring piston is in contact with the cylinder D, an automatic adjustable packing block j^3 (Fig 2) is used. Also, it will be clear that the wings in making a revolution do not rub against the sides of the casings B and B^2, as these casings likewise revolve, wings merely slipping in and out against them a short distance; the wings, however, do not touch any portion of the cylinder D in revolving, as they are packed on their sides and ends with two L-shaped pieces and a V-shaped block, adjusted by springs, which again secure perfect steam tightness with a minimum of friction.

ACETYLENE FROM THE UNDERWRITERS' STANDPOINT.

Since calcium carbide has become an article of commerce, and acetylene gas is being employed as an illuminant, especially in country places and small towns where fire protection is inadequate, the conditions under which the carbide may be safely manufactured, handled, and stored, and the resulting acetylene gas produced and employed, has become a matter of the greatest importance to the companies engaged in the business of fire insurance. The underwriters of Ontario have published a set of rules for the use of calcium carbide and acetylene gas which are much more severe than those laid down by the underwriters of Manitoba. The London Ins. Co., London, Ont., the Perth Ins. Co., Stratford, Ont., Wellington of Guelph, and the Millers' and Manufacturers' Ins. Co., Toronto, have secured a special report on calcium carbide and acetylene gas from Prof. E. B. Shuttleworth, F.C.S., whose wide experience and recognized ability as a chemist and analyst give his conclusions much weight. We append Prof. Shuttleworth's report:—

In comformity with your instructions I herewith submit the result of a study of acetylene with especial reference to the risks involved in its manufacture and use. When viewed from this standpoint the subject presents certain subdivisions, each of which demands separate consideration, so that the conclusions formed may be directly available for insurance purposes. Before entering upon a discussion of these questions I would explain that as the literature of the subject is, so far, almost exclusively confined to papers and articles which have appeared in technical and scientific periodicals during the past two years, I shall take the opportunity of recording those facts which are likely to prove of interest or value to the underwriter. I propose to present the subject under the following general headings:—Manufacture, storage and carriage of calcium carbide; manufacture of acetylene at low pressures; use of low pressure acetylene for illuminating purposes; use of compresses or liquefied acetylene for illuminating purposes.

MANUFACTURE OF CALCIUM CARBIDE.

The preparation of carbide as carried on under the Willson process, patented in 1894, consists in submitting a mixture of powdered lime and charcoal, or coke, to the heat of a powerful electrical furnace, in which the temperature probably reaches 10,000° F. The lime, which chemically speaking, is oxide of calcium, is decomposed, the oxygen being replaced by carbon. In the ordinary working scale it requires about six hours to effect the change. The result being a pig of fused carbide weighing about 500 pounds. The mass is removed by a hydraulic crane and allowed to cool. This requires about two days, when the carbide is broken up, by sledges, into pieces which will pass through a 5-inch opening, and is packed in strong tins furnished with a screw-cap and generally holding 100 pounds. These tins are afterwards encased, in pairs, in a strong wooden box. This is the plan pursued at the Willson Carbide Works, on the Welland Canal, at Merritton, from which the Canadian supply of carbide is, in great part, derived. On October 29th, by invitation of the inventor, I had the privilege of thoroughly inspecting the entire works and witnessing all phases of the manufacture. These works commenced operations in August, 1896, and are now turning out about sixteen pigs, or about four tons, per day. A second factory is almost completed, at a lock lower down the canal, and a third is being built still further below. The energy at command in these establishments will equal over 1,500 horse-power. The factories cost about $30,000 each.

The carbide produced is in exceedingly hard pieces, of a grayish-black color; semi-crystalline in structure; about two and a half times heavier than water (sp. gr. 2.26). Commercial carbide is never pure, that of good quality containing 80 to 90 per cent. of the true compound. It is liable to contain calcium phosphide, an impurity which, in the production of acetylene, may give rise to spontaneously inflammable gas, and thus cause accident. This will be afterwards alluded to. Analyses of European carbide have sometimes shown as much as 3 per cent. of phosphide, derived from impure lime, or coke. It is claimed that the Canadian product is made from lime which contains only 0.96 of impurity, other than magnesia, and that, as far as known, it is free from phosphide. This would have to be determined by actual analysis. Carbide is not inflammable, does not explode by friction or shock, as abundantly evidenced by the rough handling it receives in breaking. It is not affected by dry steam, but when exposed to the air, quickly combines with the watery vapor present, and gradually evolves the gas, acetylene. This is formed by union with the hydrogen of the water, the oxygen and part of the hydrogen combining with the calcium, thus producing slaked lime. In other words, carbide of calcium, plus water, yields hydrate of calcium, plus acetylene. In the presence of moist air this change goes on very slowly, as the coating of lime formed on the lumps of carbide acts as a protective. The gas generated passes off into the air, and under practical conditions, as in carbide works, is not at all likely to do harm, It has been asserted that when a quantity of powdered carbide is brought into contact with a relatively small amount of water, the heat produced is sufficient to ignite the liberated acetylene, but I have not been able to bring about this result at ordinary air pressures. The heat liberated is, no doubt, carried off by the watery vapor generated, and the temperature does not, therefore, rise above boiling.

In the Merritton, Ont., works there were in the same room four electrical furnaces, in active operation, with their attendant heat and flame; on the floor were at least twenty pigs of carbide, some of them white hot, and several resting in shallow pools of water formed from leaks in the hydraulic hoist apparatus. I was informed that from August, 1896, until Jan., 1897, the pigs of carbide were not cooled by exposure to air, as at present, but by playing on them with a hose. The risks of percussion

were fully represented by the sledge-hammer blows constantly falling on the lumps of carbide, and I saw no evidence of the production of flame in this way, as stated by one author. None of the window openings were fitted with sashes, and in rainy weather, accompanied with wind, much water would, undoubtedly, blow on to the carbide distributed over the floor. Radiated heat, heat of percussion, flame, and water, existed concurrently in this apartment, but no injury resulted, and I was assured by Mr. Willson that none had been realized, or was anticipated.

I believe that buildings for the manufacture of carbide should for insurance purposes, occupy a position combining the conditions present in foundries, and places where electrical energy is developed. They should be built with fireproof walls, preferably of corrugated iron; be well ventilated and lofty, so as to provide for the quick and complete dilution, and rapid escape of any evolved gases.

STORAGE OF CARBIDE.

Much of what has been just stated is applicable to the question of the storage of carbide. In the absence of water the compound is no more dangerous than is so much limestone. With water there is the formation of acetylene gas, but, except pressure is thus generated—a condition which, under such circumstances, is difficult of fulfillment—there is practically no liability to accident in the absence of flame. Water and fire together constitute the element of danger, while in the case of gunpowder and other explosives, and with inflammable liquids, as alcohol, gasoline, turpentine, etc., the latter is alone sufficient. The difference in risk is in some degree proportional to the probability of a co existence of the disturbing conditions. At the time that the fire took place at the Polson Works, at the foot of Sherbourne street, Toronto, there were standing in the building two tins containing carbide. The heat was sufficient to melt the solder of the tins, but the carbide was quite unaffected It is not likely that this would have been the case with gunpowder, varnish, coal oil, or any of the liquids mentioned. In the furnace room of the Willson Carbide Works, already described, there was stored, at the time of my visit, some 80 tons of carbide, packed in tins and cases, and piled about ten tiers high. This was stated to be a small stock, and supplies of carbide had been stored here for more than a year, without accident, though fire and water were always in close proximity.

I am of opinion, with proper provision for keeping the carbide in substantial, properly sealed, water-tight, metallic cases, enclosed in wood in order to protect the tins from external violence, and the storing of such packages in a well-ventilated apartment, the risk would not at most be greater than with ordinary inflammable liquids.

CARRIAGE OF CARBIDE.

This question may for the most part be decided by the arguments already brought forward, but there is introduced a new element of danger in the transmission of the carbide by water, where there is a possibility of partial or complete submergence in that element, and where packages might be stored in the unventilated, damp holds of vessels. From imperfect sealing there might be slow evolution, with consequent accumulation of gas, which, by admixture with air and subsequent contact with flame, might produce explosion. In order to test whether the ordinary commercial package was impervious to water an experiment was made at the Merritton Works, of which the details were communicated to me. Two 100 lb. tins were suspended for several days in the tail-race, where they were completely immersed and subjected to some motion. At the close of the trial one of the tins had suffered a loss of six pounds of the carbide, and the other was intact.

I desired to ascertain whether the sudden inrush of water, and the subsequent application of flame, would give rise to explosion of an ordinary commercial package. I therefore made an experiment, which, from the quantity of carbide operated upon, might be considered of an ultra-crucial character. A full 100-lb. package was selected at random from a large number. The tin was 12 inches square by 18 inches in height, and was made of IXX sheet steel of 27 gauge, with an opening of five inches closed by a screw-cap. The cover was removed, a gallon of water instantly dashed in, and a light applied. The result could not in any sense be called an explosion. There was a sudden ignition of the evolved gas, which continued to burn quietly to the height of about 18 inches for 10 or 15 minutes, when more water was thrown in, producing a slight increase of flame. The gas continued to burn for about half an hour. The heat produced was only sufficient to melt the solder off the screw collar at the top of the tin. There was some diminution in the bulk of the carbide, but the larger pieces remained intact, and when the crust of lime was brushed off, were otherwise unchanged. The experiment clearly demonstrated that, under the trying conditions described, the ignition of the gas from the admixture of relatively large quantities of carbide and water would not give rise to an explosion, while the combustion was not more uncontrollable than would have been the case with many inflammable liquids.

I think that the carriage of carbide in the close holds of vessels should be subject to restrictions, and is attended with some risk.

MANUFACTURE AND USE OF ACETYLENE AT LOW PRESSURES.

The manufacture and use of acetylene at low pressures, slightly over that of the air, and not exceeding say 1½ ozs. to the square inch, must be considered separately from that of more strongly compressed or liquefied gas. The latter are of a much more unstable and dangerous character, and their behavior towards disturbing agencies is, so far, imperfectly understood. Acetylene, as before stated, is produced by bringing calcium carbide in contact with water. One pound of carbide should yield, theoretically, over 5½ cubic feet of gas, but owing to the impurity and deterioration of the carbide, only about five feet are produced, manufacturers usually guaranteeing 4.66 feet. The reaction is very vigorous, gas being liberated with great rapidity, and with the formation of much heat.

The gas is of specific gravity, 0.91, and is, therefore, nearly one-tenth lighter than air and about twice as heavy as coal gas. It possesses a peculiar and disagreeable odor—a character which serves as a useful warning of its presence, and the consequent detection of leaks. At air temperatures it can be liquefied by a pressure of about 600 pounds to the square inch, and by extreme cold can be solidified. Acetylene is stated to be more inflammable than any other gas, not even excepting hydrogen. The point of ignition is about 900°, that of coal gas being near 1,400°. The flame produced is exceedingly luminous, being variously estimated at 10 to 20 greater than that emitted in the combustion of an equal volume of ordinary gas. The products formed are mainly carbonic acid and water, with little if any combustible gas containing carbon. These products, as also the heat generated from flames of equal luminosity, are much less with acetylene than coal gas, or carburetted water gas. When acetylene

is mixed with air in the proportion of three per cent. of the former, the mixture begins to be slightly explosive; at little over eight per cent. the maximum explosive effect is reached, and when the acetylene reaches eighty-five per cent. explosiveness ceases. With coal gas the limits of explosion are between five and twenty-eight per cent, and with water gas from nine to fifty-five per cent. The maximum explosive effect with acetylene is reached when the proportion is 1 to 12 of air; with coal gas, 1 to 6; and water gas, 1 to 1. It is thus evident that acetylene begins to be explosive with a less admixture of air than either water or coal gas, and that it retains its explosiveness through a greater range.

If acetylene, at a pressure of over two atmospheres, is heated to 1,437° F., it is dissociated or resolved into its constituent elements, carbon and hydrogen, the former being deposited. Dissociation is accompanied by the sudden liberation of much heat, with a corresponding rise of pressure, and consequent explosive effect. While acetylene, without admixture of air, is strongly explosive, it must be remembered that in the experiments by which this was established, the gas was always under pressure, and in most cases was heated by the container being placed directly over a flame of fire. It has not been shown that at air pressure the gas can be exploded by heat, shock, detonation, the electric spark or by a white-hot platinum wire. Though decomposition may be thus set up it is confined to the point of disturbance, and is not propagated to the mass of the gas. It is asserted that this result will not follow so long as the gas is under pressure of less than two atmospheres. If acetylene at low pressures be confined in a receiver from which a pipe passes, the end of which is closed; and at a distance of five feet from the receiver the pipe be heated to 1,437° F., sudden decomposition, accompanied by sudden pressure, will take place. If acetylene be passed through a hot porcelain tube its constituents are polymerized, or rearranged, so that the product is no longer acetylene, but may appear as naphthalene, or other solid or semi-solid hydrocarbon. This is the result of heat on uncompressed gas, and indicates a danger in the blocking up of pipes and burners traversed by heated acetylene.

The impurities of acetylene are due to foreign matter in the carbide, and as far as relates to the subject of this investigation, are phosphuretted hydrogen, siliciuretted hydrogen, and ammonia. The two former are spontaneously inflammable, and are thus a source of danger, while the latter may attack copper or brass portions of the apparatus, which, by subsequent contact with moist gas may form explosive compounds. These compounds consist mainly of cuprous acetylide, and do not appear to be formed except the copper or alloy is oxidized, or perhaps only when an ammoniacal compound is generated. Pure, dry acetylene does not combine with copper. The copper salts are very sensitive to shock, friction, or heat, and when exploded may serve as detonators, though, as previously stated, the explosion in uncompressed gas would be merely local, but under 30 lbs. to the inch the impulse would be transmitted to the mass of acetylene.

The above facts thus briefly summarized, point out certain dangers to which the manufacture and use of low pressure acetylene is liable. They may be enumerated as follows, an attempt having been made at arrangement in sequence of importance :—

1. Formation of explosive mixtures of acetylene and air, as produced by defects in generating apparatus, or escape of gas through fixtures. 2. Production of heat and pressure by the too rapid decomposition of the carbide. 3. Secondary formation of gas by watery vapor, or the dehydration of slaked lime by the carbide, after the conclusion of the ordinary process. 4. Generation of dangerous pressures in apparatus insufficiently provided with relief attachments. 5. Formation of explosive compounds with copper or its alloys. 6. Production of spontaneously inflammable gases originating in impurities in the carbide. 7. Blocking of pipes by solid hydrocarbons resulting from polymerization of acetylene. 8. Evolution of gas from imperfectly exhausted carbide residues.

Before discussing these points, it may be said that the apparatus for generating acetylene consists primarily in an appliance for producing the gas, and a receiver for holding it for distribution. Generators are of two kinds. In one the carbide is brought in contact with a relatively small quantity of water, projected automatically; in the other, the carbide is put into a relatively large quantity of water.

(1). Acetylene, as has been shown, forms an explosive mixture with air, as do other illuminating gases. The question is merely that of degree, and this is indicated by the figures given, but it must also be remembered that the acetylene mixture is more powerfully explosive than are those of the other gases. In forming a general conclusion, the fact of the different diffusibilities of the gases must also be taken into account. Coal gas, on account of its lower specific gravity, would issue much more rapidly from a leak than would acetylene, but against this must be set the fact that the latter, being much heavier than coal gas, would be more liable to accumulate in badly ventilated spaces. In the case of escape of gas from an unlit, open burner, the quantity of acetylene would be much less than that of coal gas, not only for the reason stated, but on account of the diminished capacity of acetylene burners, which only allow about one cubic foot to pass per hour, while those for coal gas are usually arranged for five times this volume. When these facts are balanced against one another the danger of accident from explosive mixtures with air does not appear to be appreciably greater with acetylene than with coal gas.

(2) That explosion, by dissociation, is possible from a too rapid decomposition of carbide seems to have been domonstrated by good authorities in Europe. I have repeated some of the experiments made, in one case operating on ten pounds of carbide, but, perhaps fortunately, without confirming the results obtained by others. The fact that carbide will not combine with dry steam at a high temperature is against the theory of explosion, which necessitates the presumption of a temperature of 1,437° F., as determined by Gerdes, of Pintsche's laboratory. If a lump of carbide be heated on an open fire and sprinkled with water, inflammable gas is not produced. In view, however, of our somewhat uncertain knowledge of commercial carbide, under such circumstances, it is necessary to make provision against possible accidents, and this is, no doubt, one of the objects sought by generator manufacturers. With properly constructed apparatus the danger of accident might be entirely obviated.

(3) The secondary production of gas, after the first effect of the addition of water to carbide has taken place, may always be observed. The heat of the reaction generates steam, which mixes with the gas in the generator, and afterwards condenses on the carbide, thus giving rise to a second, but relatively feebler evolution of gas. The affinity of carbide for water is also so great that it will dehydrate the slaked lime, with which each lump of carbide is coated, thus bringing about slow production of gas. While consumption from the receiver is going on there is

not much likelihood of the accumulation of pressure, but if the gas is not being used such result would follow, but could be provided for by a relief valve, or water seal, opening outside the premises. The danger, like the former, is dependent on the construction of the apparatus.

(4) Dangerous pressures, from any cause, can be similarly met.

(5) With regard to the presence of explosive copper compounds, it has been shown that such are dangerous in acetylene at high pressures. But authorities agree that at air pressure, and when not exceeding two atmospheres, the effect of such disturbing agents is that of only bringing about local detonation, which is not transmitted to the body of the gas. It has been proved that the presence of ammonia is the prime cause of the formation of these copper salts, and provision might be made against danger by the avoidance of copper or brass in the construction of apparatus.

(6) Several explosions of compressed acetylene are reported as having possibly originated in phosphuretted or siliciuretted hydrogen generated from impure carbide. It is likely that such might be dangerous constituents of low pressure gas. In view of this some provision for the inspection or analysis of carbide should be put in force. This might take the form of a guarantee of purity furnished by manufacturers.

(7) The blocking of pipes by solid hydrocarbons, as naphthalene is common enough where water gas is wholly or in part used, as in Toronto. In the case of acetylene the danger would not be as great, and with properly constructed generators and burners need not be realized at all.

(8) There is some possibility that in the residue from generators there might be small pieces of undecomposed carbide mixed with the lime. These would slowly give off gas, which, by contact with flame, would, it is thought, be a source of danger. I have examined such residues, taken from a large generator while in action, but could not succeed in detecting, by flame test, the presence of inflammable gas. Generators are mostly fitted, for economic reasons, with a grating, which only permits of a passage of small pieces of carbide, or residue. I do not think such residues are as dangerous as wood ashes as removed from domestic stoves. The above enumeration fairly exhausts the list of risks involved in the manufacture and use of low pressure acetylene. The next point of enquiry is that of ascertaining whether these dangers have been actually realized. In order to carry out this purpose I have searched for records of accidents the files of likely periodicals, and have succeeded in finding notes of a few cases, though in most of the accounts the information is meagre, and in some instances indefinite, especially as to the state of compression of the gas. To these you will doubtless be able to add others from insurance records. The following is not given as being complete, but simply comprising all the cases which I have been able to find:

Accident alluded to by Smithells, in remarks on Berthelot and Vieille's communication to the French Academy of Science. Carbide in generator thought to have become incandescent from insufficient supply of water. Particulars not given, nor pressure of gas stated. A plumber at Egremont, Cheshire, constructed and used an acetylene apparatus. Supposing the "receiver" to be empty he took off the cover, the result being an explosion by which he was so much injured that death shortly after resulted. The coroner thought the explosion was caused by the admixture of air with the gas remaining in the receiver. There is here a possibility of the presence of spontaneously inflammable phosphoretted hydrogen. Infante reports the explosion of a home-made apparatus. Smithells thinks that it was due to phosphoretted hydrogen, and that the receiver contained air. Two explosions took place in New York from the escape of gas from acetylene apparatus. The presence of flame might here be presumed. Another New York accident resulted from the cover of a generator being removed while a lighted candle was in close proximity. An explosion is said to have taken place lately at Arkona, Ontario, by which several persons were slightly injured. The owner is stated to have been in the act of showing the apparatus to some of his friends, a lamp being used as a source of illumination. Explosion followed the removal of the cover of the generator. The last four accidents evidently took place with low pressure acetylene, and were all probably due to the proximity of flame. This indicates what I believe will prove to be the chief source of danger.

GENERAL CONCLUSIONS.

(1) Calcium carbide factories may be classed in the same category as iron foundries, with the additional risk incident to electrical plant.

(2) The storage of carbide should be subject to the conditions governing that of inflammable liquids. Packages to be of sheet steel, of at least twenty-seven gauge, well tinned, having seamed and soldered joints, and furnished with water-tight metallic caps. Packages to be further protected by being enclosed in strong wooden cases. Place of storage to be well ventilated, dry and well drained.

(3) Carriage of carbide, by water, to be held to involve extra risk.

(4) Carbide to be free from phosphoretted or siliciuretted compounds, as determined by analysis, or assured by guarantee.

(5) Apparatus for generating acetylene to be inspected and approved before use, and to embody certain general features of construction to be hereafter specified.

(6) Rooms for the installment of apparatus to be well drained, free from dampness, and provided with sufficient overhead ventilation communicating directly with the open air. No fire, flame, or artificial light to be allowed in apparatus room, nor are such places to be used for any other purposes than that indicated.

(7) Manufacture of gas to be carried out by a properly instructed and capable person, and never to be attempted except by daylight.

(8) Residues from generator to be removed by daylight, and directly deposited at a proper distance from any building.

(9) The use of acetylene gas, for lighting purposes, need not be placed under any special restrictions when the apparatus is not located in the building, and at a safe distance from it.

USE OF COMPRESSED AND LIQUID ACETYLENE AND CARBIDE LAMPS.

It is more than probable that this question will, in time, become of considerable moment, and demand attention. In view, however, of the serious accidents which have already occurred, even in the laboratories of the most experienced gas chemists; and until the peculiarities of compressed and liquid acetylene are more perfectly understood, and better control apparatus has been devised, I think the underwriter may most profitably decline all business involving risk with these dangerous substances.

I have formulated, and herewith enclose a draft of regulations governing the installation and use of gas machines. I have the honor to be, Sir,

Your obedient servant,

E. B. SHUTTLEWORTH.

Toronto, Nov. 12th, 1897.

RULES FOR THE INSTALLATION AND USE OF ACETYLENE GAS APPARATUS.

(1) No generating apparatus shall be installed without the approval of the company has been obtained. Such approval shall only be granted after proper inspection by a qualified person appointed by the company. Makers of apparatus may have any particular design inspected, and to this end shall submit the necessary drawings and specifications and shall provide facilities for examining and testing the machine. If the inspection prove satisfactory the approval of the company to this particular form of apparatus may be secured provided the manufacturer signs an undertaking that the construction and design of such apparatus shall remain unchanged and in conformity with the drawings and specifications deposited with the company. The cost of inspection must be borne by the party who makes the application. Approved apparatus shall embody the following features: Generator and gas holder to be of proper relative proportions, and both of sufficient capacity for the requirements of the gas consumption of one day. Generator, gas holders and connections to be substantial; not subject to corrosion, and free from any parts of copper or its alloys. Pipes and connections to be of sufficient size and not subject to clogging. Adequate provision by liquid seals for the relief of gas pressure greater than that of three inches of water; and for the free discharge of surplus gas in the open air. Reliable automatic device for bringing the carbide into contact with the proper quantity of water.

(2) Location of apparatus. No apparatus shall be put into operation in a room in which there is a fire, or where any artificial light is used, even momentarily; or where the temperature is liable to fall below the freezing point. Apparatus room shall not be used for any purpose other than the manufacture of gas, and the storage of the necessary quantity of carbide. They shall be well drained, free from dampness, and provided with sufficient over-head ventilation communicating directly with the open air.

(3) Working of apparatus. All operations shall be conducted by daylight, and only by persons properly instructed in such work, and whose qualifications have been approved by the company. Residues from generators shall be removed by daylight and at once deposited at a safe distance from any wooden building.

(4) Storage of carbide. Carbide for use must be of guaranteed quality; stored in packages of sheet steel of at least 27 guage well-tinned, having seamed and soldered joints, and furnished with water-tight metallic caps. Such must be kept only in the apparatus room.

(5) The manufacture and use of acetylene at higher pressure than that of three inches of water is absolutely prohibited. This restriction to extend to carbide lamps.

—The Ontario Government still has the power question before it, and from present indications some measure of relief is contemplated. It is impossible for a Government which showed such wisdom in its timber policy to stultify itself by continuing its old anti-Canadian policy.

—A correspondent informs us that he has been making experiments with acetylene gas as a motive power for gas engines, and finds that when running at high speeds, he can get more power out of acetylene gas than out of coal gas. Experiments were made in a rotary engine, and showed that quicker explosions could be got from acetylene than from coal gas. When running at speeds under 300 revolutions per minute, the difference is not much, if any, in favor of acetylene; but at 450 revolutions per minute the advantage is quite marked, and by getting heavier compression he has been able to run the speed up to 750 revolutions per minute, with marked results in favor of acetylene.

—The good things of Canada are, perhaps, after all to be preserved for Canadians, and the resources of our country used to develop it. The Ontario Government has followed out the policy outlined in THE CANADIAN ENGINEER and the press generally, and has passed a bill obliging the holders of new timber licenses to manufacture the logs they cut in Canadian territory by Canadian labor and on Canadian soil. The Dominion Government has, it is just announced, decided to limit the exportation of natural gas. If sufficient pressure can be brought upon the Dominion Government to induce it to bring into operation duties against the export of unrefined nickel, we may see prosperity ahead of Canada at last.

—McGill University is once more to be indebted to W. C. McDonald for princely gifts. He recently announced his intention of endowing a second chair of Chemistry with $200,000. This, added to the former gifts of the Chemistry building, equipment, maintenance, and the endowment of the professorship, makes a total of $575,000 to this department. The Faculty of Law is also to be fortified by the addition of $50,000 to the endowment of $150,000 furnished a few years ago. In addition to this Mr. McDonald intends to institute an auxiliary fund of $200,000 to be used for the general needs of those departments which are connected with his name. Mr. McDonald's gifts to McGill now amount to nearly one and a half millions.

THE MICHIPICOTEN GOLD FIELDS.

The Ontario Government in September commissioned A. B. Willmott, M.A., B.Sc., to examine the Michipicoten mining division, which had just been created, owing to the reports received by the Government of extensive finds of gold in that neighborhood. The following paragraphs are condensed from Prof. Willmott's report to the Bureau of Mines, recently issued by it in pamphlet form:

"Except a very small area at Cape Gargantua the rocks of the Michipicoten division belong to the Laurentian and Huronian systems. Of the former system, the almost universal rock is gray gneiss, finely grained, and not particularly well stratified. At many places it becomes thoroughly granitic in structure, and then is often coarser-grained. At a few places it was quite pegmatitic. While usually a dull grey in color, there are limited localities where a red felspar has given brighter tone to the rock. Syenites are found in small areas. The Huronian rocks are more varied in character. Massive diorites, diabases and hornblende, and chlorite schists are most common. Slates, felsites, quartz porphyries, quartzites and sericite schists are less common. Occasionally conglomerates were seen. At the contact between the two it always appears that the Laurentian gneiss or granite has been erupted into the Huronian rock, and is therefore later in age. The schists are nearly always vertical, and strike in various directions, depending on their relation to the intrusive granites. No clear distinction could be seen in the field between eruptive granites and the ordinary gneiss, and no case was observed where a granite had been erupted in the gneiss. Dikes of diorite are, however, frequently found in both the Laurentian and Huronian rocks.

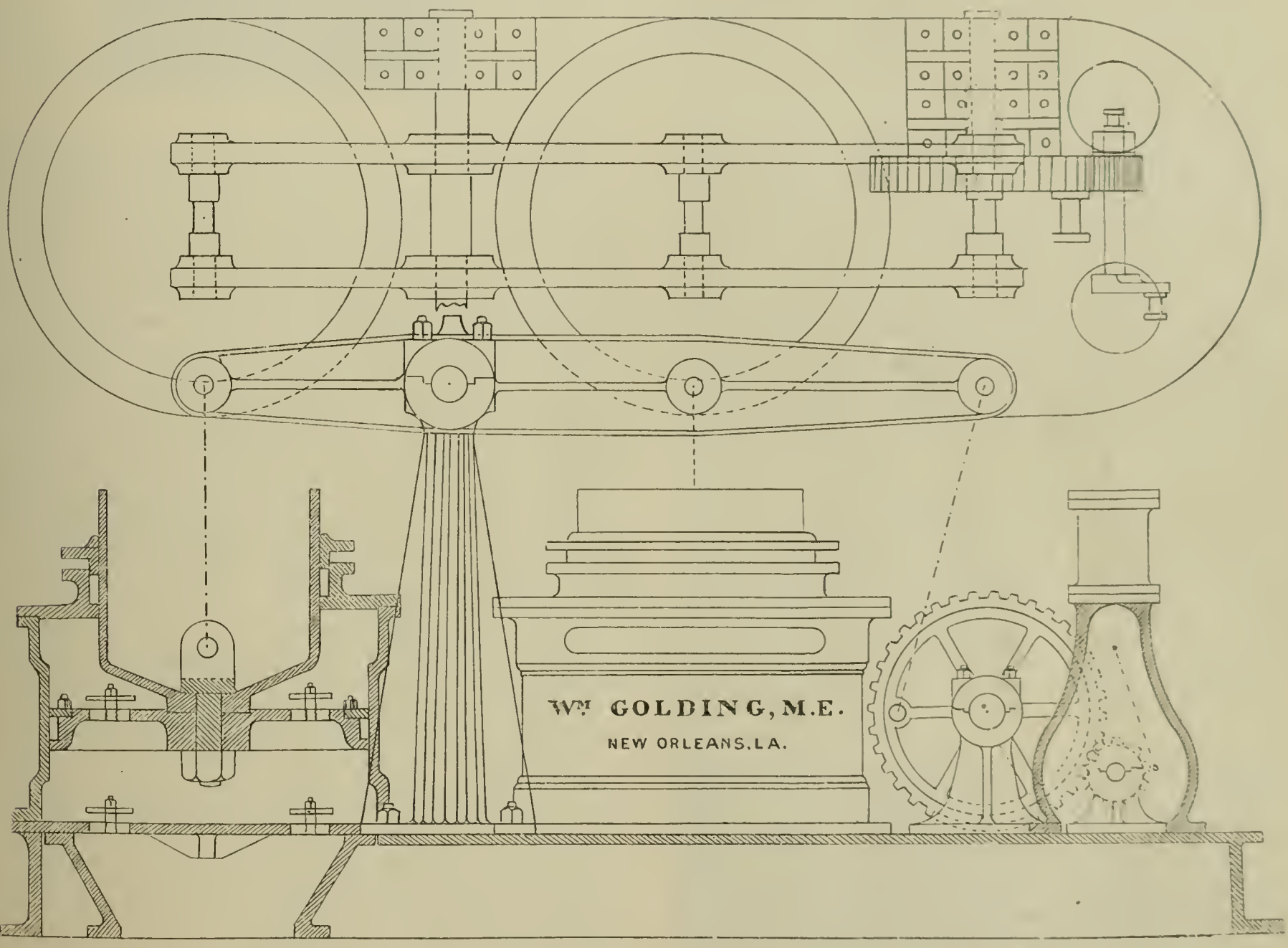
The metal most likely to be found in large amounts in this district, is gold, though discoveries of nickel, iron, copper and silver have also been reported. Almost nothing is yet known definitely as to the occurrence of any of these. Gold has been found at a number of places in visible particles, and in all cases simply chipped from the surface. At no place in the division has a pit been sunk to a depth of over ten feet, and in all the recent prospecting for gold not more than a single shot has been put in at any one point. What little prospecting has been done has been entirely confined to Lake Wawa and the canoe route north to Missanabie. Even here few men have gone more than three miles inland. At the most, a strip

six miles wide by forty long has been examined, and this in the most superficial manner, for several reasons. Many of the prospectors who have recently turned their attention to the field are utterly unfitted for the task. Fully three-fourths of those I met did not know how to pan, and could not tell when they had quartz of value," says Prof. Willmott. "Even for experienced woodsmen this region is a hard one to prospect. The cliffs are so steep, and in some regions the rocks are so completely enshrouded in moss that it takes days to prospect a very small area. The number of quartz veins seems to be large, to judge from reports given me by prospectors. Many of those I saw were very wide, and not infrequently formed the precipitous sides of high cliffs. In this case they are somewhat easily traced, often for a considerable distance. In nearly every case the veins are bedded ones, following the strike of the schists. On the whole the quartz seems white and does not usually carry any large amount of sulphides. Iron and copper pyrites are the chief minerals of the quartz, though galena and pyrrhotite are occasionally found.

So far the best finds are in the vicinity of Wawa Lake and on Manitowick Lake. Similar country rocks are, however, widely spread, and equally good deposits are quite as likely to be discovered in the future. Only a fringe has yet been prospected. As to placer gold, the early reports have proved to be false. The present streams are but reassorting glacial drift, and it is not probable that gold will be found in their beds. As to their old valleys, the case may be different, but no one has yet reached them. As to other minerals, little can be said. Native copper occurs in considerable amounts on Michipicoten Island, in the formation which on the south shore is proving so remunerative. Cape Gargantua is composed of the same formation."

IRRIGATING PUMP.

The accompanying illustration shows a type of pump, suitable for moving either air or water, and designed especially for irrigating or draining land, where the lift is beyond the economic capacity of the centrifugal pump, and where large volumes are required to be moved. The feature of this combination is, that it can be operated by any power available, either by electricity or by a small steam or oil engine. The pump portion is of the type known as the "bucket plunger." The plunger, being one-half the area of the cylinder, will displace one-half the volume, while descending, and one-half while ascending, thus effecting a continuous discharge. The suction pipe to each will be independent, so that one pump can be used for circulating, while the other is being used for vacuum or other purposes. As will be observed, the combination is entirely self-contained, and may be lightened to any extent for facility of transportation. The engraving is made to scale of half-inch to the foot, for a combination having capacity to move five thousand gallons per minute. This pump is designed by Wm. Golding, M.E., New Orleans.



THE GEOLOGICAL SOCIETY OF AMERICA.

The tenth annual meeting of the Geological Society of America was held in the Redpath Museum, McGill University, Montreal, from 28th to 30th of December.

The ballot for the election of officers resulted as follows: President, J. J. Stevenson, New York city; First Vice-President, B. K. Emerson, Amherst, Mass.; Second Vice-President, G. M. Dawson, Ottawa; Secretary, H. L. Fairchild, Rochester, N.Y.; Treasurer, I. C. White, Morgantown, W. Va.; Editor, J. Stanley-Brown, Washington, D.C.; Librarian, H. P. Cushing, Cleveland, Ohio; Councilors—W. M. Davis (for unexpired term of B. K. Emerson); Robert Bell, Ottawa; M. E. Wadsworth, Houghton, Mich.

At the evening meeting Dr. Dawson introduced the retiring president, Dr. Edward Orton, who delivered the annual address, selecting for his subject the "Geological Probabilities as to Petroleum." He referred to Sir William Dawson as standing high in the list of those who had preceded him in office, and said that, standing within the precincts of McGill University, they might adopt the words: "Si Monumentum requiris, circumspice." He then proceeded to point out some of the principal geological probabilities as to petroleum and its derivatives, and stated that the subject he had chosen for his address had some peculiar claims on geologists. Petroleum was a form of stored power, and geologists knew better than other

men the priceless value of such accumulations. Geologists knew that on them the well-being and progress of the race largely depended, and that without them civilization could not long maintain the pace which the nineteenth century had set. They knew that these stocks of buried light, heat, and power were small at the best, and that they demanded the most careful husbandry. They knew, too, that petroleum and its derivatives, by virtue of their essential characteristics, were especially opposed to waste, either through ignorance, recklessness, or speculative greed, or through all combined. It would be a reproach to have the experience of Pittsburg and some other places indefinitely repeated; it would be a lasting reproach to have the important exploitation of petroleum restricted by the exhaustion of its stocks before the end of the century in which it was begun, and fifty years of which still remained.

The programme included some thirty papers, and of those most interesting to our readers, Prof. Chamberlain read one by Prof. Warren Upham, on "The Niagara Gorge and St. David's Channel." The writer said that having recently again examined the Niagara Falls and gorge, with especial reference to the older channel of St. David's, the author believes that a most important element in the history of the gorge erosion has been overlooked by some observers, and that by others its evidences have been misunderstood. This paper shows that the small preglacial stream which eroded the St. David's and Whirlpool channel, having a great depth beneath the river in the whirlpool, must have flowed for a considerable distance, before reaching that depth, in a gradually widening and deepening ravine, coinciding with the present gorge along the Whirlpool rapids. Because the Niagara River found there a drift-filled, narrow ravine, which it cut to the present size of the gorge, its erosion took place in that part by rapids and cascades. Southward from the head of the old ravine, the river has eroded its gorge by a great vertical cataract, under which the masses of the Niagara limestone, rolled about by the power of the waterfall, have worn the river bed to a maximum depth of nearly 200 feet beneath the water surface. The narrowness of the gorge along the Whirlpool Rapids is therefore attributed to the conditions of the river erosion here indicated, rather than to decrease of the volume of the river by diversion of the water of the upper lakes to flow from Lake Huron eastward. Studies of the glacial Lake Agassiz convince the author that the progress of the epeirogenic uplift of the northern United States and Canada from the Champlain depression was too rapid to accord with the hypothesis of any outflow from Lake Huron toward the east during the long time that would be required for the Niagara River, while thus diminished, to erode the gorge along the Whirlpool Rapids. The explanation here given accords mainly with Dr. Julius Pohlman's discussion of the Niagara history, but differs concerning the age of the river and of postglacial time, which is estimated, as from Prof. N. H. Winchell's discussion of the Falls of St. Anthony, to have been between 5,000 and 10,000 years.

Frank B. Taylor, of Fort Wayne, Ind., contributed some "Notes on the Moraines of the Georgian Bay Lobe of Ice-sheet." He said, when the ice-sheet had retreated in the basin of Lake Huron so far as to leave the summit of Blue Mountain, south of Georgian Bay, uncovered, there still remained a well defined glacial lobe projecting towards the southeast, nearly to Toronto and eastward beyond Lake Simcoe. This lobe was divided in two parts by the Penetang peninsula, the larger one extending southeast from Nottawasaga Bay, and the smaller one extending east, southeast from Matchedash Bay. Recently the moraines of the eastern limb of the Nottawasaga lobe were partially explored and a well defined series of five moraines was found filling the interval from the head of Georgian Bay to the "Oak ridges" north of Toronto. During the later stages of this lobe there was a glacial lake covering Lake Simcoe and a considerable area to the east, and probably held up on that side by a lobe projecting from the north-east up the valley of the Trent River. Its beach is 90 to 100 feet above Georgian Bay, running S. 60 deg. E. Some of the moraines running along the east side of Lake Huron were also traced northward to the vicinity of Durham and Flesherton.

Prof. F. D. Adams, of McGill University, read some notes on the "Geology of Montreal and Vicinity." All of these papers were purely technical in their character, and were chiefly interesting to scientific men in general and geologists in particular. Prof. Adams' paper was a most exhaustive one, and dealt with the geological formations of this portion of Canada from the post-pliocene period onward. He especially drew attention to the volcanic nature of the district of Montreal; to the large deposits of Trenton limestone and Utica shale to be found hereabouts; to the presence of marine fossils at the base of the mountain, which, he said, went to show that the district now lying between the river and the mountain was at one time submerged in water and ice, thus making an island out of the mountain. The first shore line was in the middle of Beaver Hall Hill, the next at Dorchester street, and another at Sherbrooke street, besides several others, at which heights the river had remained for some time. The mountain is 800 feet high, and the highest shore line is 625 feet high, so that when the water was at its highest there was always a small island. He also pointed out the character of the different stratas of the earth and rock which had been met with in excavating the foundations of Montreal's principal buildings, and in conclusion gave a brief summary of the topography of the island and the changes which had taken place therein since the days of Maisonneuve.

Dr. H. M. Ami gave an account of "The Mastodon in Western Ontario," speaking particularly of the remains of three which had been found—two in Essex County, and one in Norfolk County—and describing the sedimentary formations in which they occurred.

Dr. Robert Bell, of Ottawa, read two papers—one on "Mastodon and Mammoth Remains found near Hudson Bay," and another on "Fossil-like Forms in Sault Ste. Marie Sandstone." Under the former heading he gave an account of the discovery of some mastodon bones in 1877 near the junction of the Mattagomi and Missinaibi rivers, to form the Moose river, in the southern part of the basin of Hudson Bay, and describes the superficial deposits in that region, and of the finding of a peculiarly small mammoth's tooth on Long Island off the Eastmain coast of Hudson Bay. He discussed the question of the specific identity of this small mammoth with the common species of more southern latitudes in North America. Under the second heading he stated that in the bottom of the pit which was excavated in the sandstone for the canal lock on the south side of the Sault Ste. Marie in 1891, a bed was found covered with very distinct markings, which in some respects resemble large plant remains, but they are probably casts of desiccation cracks. The author's remarks will be illustrated by photographs of four large specimens.

Prof. A. P. Coleman treated of "Clastic Huronian Rocks of Western Ontario, and the Relation of Huronian to Laurentian." He spoke of the rocks themselves, and of their arrangement in the region; and a few remarks on the same subject were made by Dr. Bell, who had worked geologically in that district.

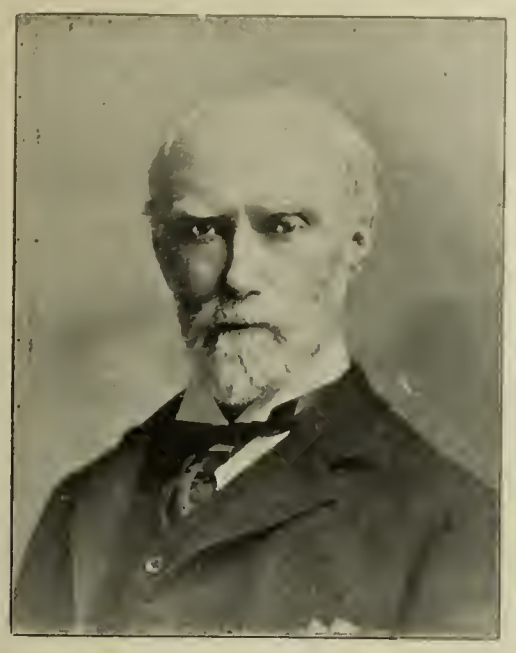
Other papers of Canadian interest were contributed by Sir Wm. Dawson, R. W. Ellis—Notes on the Sands and Clays of the Ottawa Basin; Bailey Willis—Drift Phenomena of the Puget Sound Basin; Frank D. Adams—Nodular Granite from Pine Lake, Ont.; Nevil N. Evans—Chemical composition of the Granite from Pine Lake, Ont.; E. A. Barlow—On the occurrence of Corundum in North Hastings, Ont.; Frank D. Adams and Jno. T. Nicholson—Experiments on the flow of rocks now being conducted at McGill University.

FIFTY YEARS IN TELEGRAPHY.

The Toronto Club gave a complimentary dinner on December 22nd to H. P. Dwight, president and general manager of the Great North-western Telegraph Company. The occasion was the 69th birthday of the guest of honor, and the celebration of the jubilee of his connection with the telegraph service. Many of the most distinguished men in Canada were present at the banquet, and letters of regret were read from others who were not able to be present. In replying to the toast of "the guest of the evening," Mr. Dwight read a sketch of his early life and connection with the telegraph business, from which we take the following extracts:

"I was brought up," said Mr. Dwight, "on a small farm of 25 acres, near Oswego. When about eighteen years of age the erection of a telegraph line had just been completed between Oswego and Syracuse, and I made application and obtained permission to enter the Oswego office in order to learn the business of an operator. I had heard about this time that a

telegraph line was being built by the Montreal Telegraph Company in Canada, where I obtained employment on the line which had been erected during that season between Quebec and Toronto, a distance of 500 miles, on which some 12 or 15 offices were being opened. Mr. Wood, I might mention, was



H. P. DWIGHT.

the first pupil of Prof. Morse, and one of his most intimate friends. We took instruments along with us, and opened the office in Belleville the following day, where I was left in charge and where I performed the duties of both operator and messenger, and remained for a couple of months. At the end of that time I was ordered to Montreal, to take my place in that office as an operator, and remained there until the spring of 1850. While acting as operator I also acted occasionally as messenger, batteryman, line repairer, and in fact did everything more or less that was necessary to be done in connection with the business of the office. During the time I was in Montreal our staff consisted of four or five persons, O. S. Wood, our superintendent; myself, as chief operator (and sometimes the only one), one or two clerks, and one messenger, a faithful old soldier who delivered messages with a good deal more reliability than speed.

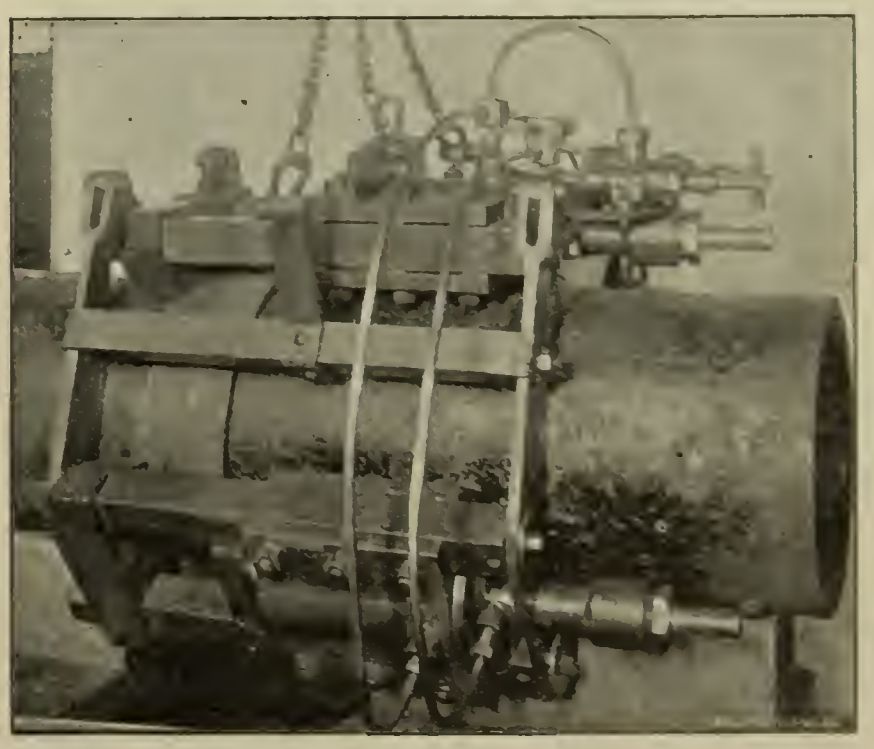
In the spring of 1850 I was sent to Toronto to take charge of the company's business here, and to be in a position to recommend such extensions in the Province of Ontario as might seem desirable. During my first year in Toronto I sent and received myself on the instruments every message which passed over the line to and from this point. I had not been long in Toronto before I began to suggest to the head office various extensions of our lines, and as these suggestions were almost invariably adopted I grew bolder and more reckless, until the head office began to get nervous and frightened. It was finally concluded, however, and I was notified by our superintendent, that I should do as I liked, it only being required that I should give notice each winter of what lines I proposed to build during the ensuing season. During the following years arrangements were made for building a line along the Great Western railway, and from time to time other railways, as they were projected and built in Ontario, such as the Port Dover & Lake Huron, the Toronto & Nipissing, the Northern, North Simcoe, Port Hope, Peterborough & Lindsay, the Midland, Grand Junction, Hamilton & Lake Erie, Hamilton & Northwestern, Lake Simcoe Junction, Welland, Whitby & Port Perry, the Victoria, the Toronto, Grey & Bruce, etc. Not only did we arrange to build lines along these different railways, most of which were afterwards consolidated with the Great Western, and the Great Western, and finally all the others with the Grand Trunk, but we also covered all the principal highways in the province. I remember well an occasion when a rather sarcastic enquiry came from the secretary of the Montreal Telegraph Company as to whether I had found any more sawmills to which I proposed to extend the lines. The policy of extension adopted, however, turned out to be a fortunate one, and to-day the map of wires covering the country looks like a thickly-woven spider's web through which a fly could scarcely escape. There is hardly a town or village of the least importance in the country which is not included in this network of lines, to say nothing of the present telephone system, so that instantaneous electrical communication is almost within the reach of every man's door.

When I commenced my career as an operator there were only two railways in the country; a short line of nine miles between Montreal and Lachine, and the other between La Prairie and St. Johns. There was not a mile of railroad in Ontario or any other part of the Dominion, and as illustrative of how one enterprise may help another it may be said that railway traffic is enormously increased by the assistance rendered by the telegraph in facilitating the movement of trains The tariff on messages in the early days was reckoned in Halifax currency. On any extensions of the lines a small additional rate was charged, until after a great many extensions charges ranged from 1s. 3d. to 5s. or 6s., and it became a question for careful consideration as to how the matter might be simplified. My advice was asked in the matter, and I procured statements from all the different offices showing the exact number of messages handled under the different rates. It was discovered that over 90 per cent. of the messages sent were under the lower rate, and consequently between offices the nearest to one another. I submitted a report to show that the difference between these high rates and a uniform rate of 25 cents would involve no great loss to the company, while it would appear to the public a very great concession, and recommended that the uniform rate should be adopted, which was done. The consequence was that business soon began to increase between the remoter points on the line.

Our system of telegraphs is in some respects precisely the same as when I learnt the business 50 years ago, but there have been many ingenious improvements made in the instruments, and in the use of the wires. One of these improvements is what is known as the quadruplex system—that is, the use of one wire between two terminal points—Toronto and Montreal, for instance—made to answer the purpose of four—one real wire, three phantom wires. Four operators do duty at each end of the line and work independently, precisely as if there were four separate wires. Before this method of using the wires was discovered such a thing would have seemed as impossible as it would now to make a single railroad track answer the purpose of four independent lines. These electrical matters are full of wonders.

RING JOINT FOR PIPES AND TUBES.

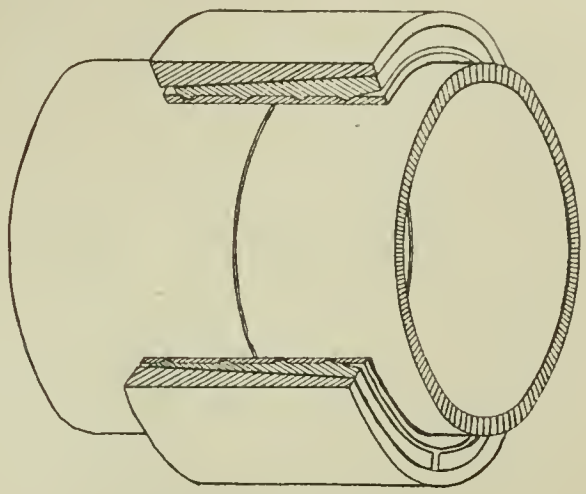
An interesting exhibition of a new method of joining iron pipes was recently given at John McDougall's Caledonia Iron Works, Montreal. It is known as the Ring Joint method, and the necessary parts are a strip of cold sheet lead, a wedge ring, made from a bar of iron or steel, ridged along its interior length, sheared to size and bent into a ring with open ends, and a compression ring, which is a rigid collar of wrought iron or steel on a plain casting, having its inner surface tapered to the form of the wedge.



The application of this joint is simple in the extreme. The strip of sheet lead is placed around the pipe with its ends slightly overlapping; over this is placed the wedge ring and the rigid compression ring is lightly fitted over the whole. The pipes are then carefully adjusted and the series of rings placed over the joint. By the application of mechanical or hydraulic pressure the compression and wedge rings are forced closely together. The wedge ring, being open, is powerfully contracted by the collar and thrusts its ridges into the

sheet lead, contracting it at the same time, thus producing a contact which approaches positive amalgamation.

This joint can be used on any kind of pipes—cast iron, welded or riveted iron and steel pipes, or on rolled longitudinally seamed pipes, such as Williams' patent. No bell sockets or specially formed ends are necessary, and cut pipes may be used. There is no waste of lead, and, since it is quite cold, no injury need result to the composition on coated pipes. The joint can be quickly removed by a few smart taps with a hammer on the compression ring, and without any damage or loss of material.

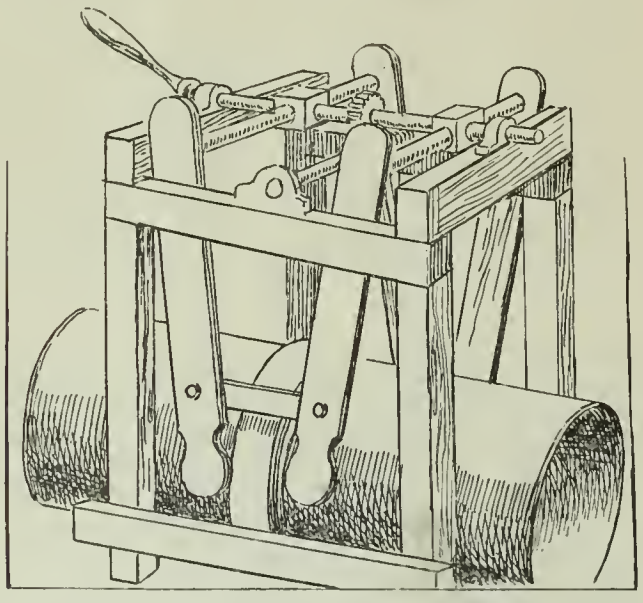


RING JOINT SHOWING METHOD OF APPLICATION.

The joint may be employed in dry or wet trenches, or under water, and is applicable to all diameters ranging from ordinary gas tubing up to the largest street mains, and is suitable for all work for which cast iron pipes are used in conveying gases, vapors and fluids.

For closing the joint on pipes and tubes of small diameter, the machine employed is a combination of tongs operated by hand screws. Pipes of large diameter are joined by means of a machine consisting of three small hydraulic presses operated by a hand pump. These tools are easily portable and can be carried along the pipe track by hand, or suitably mounted on a hand cart.

During the exhibition two iron pipes of about 18 inches diameter with plain ends were joined by this method and subjected to a water pressure of 400 feet with perfect success. The inventor is D. J. Russell Duncan, of Victoria St., London, who was in Canada recently and is already known to our readers, and the sole agents for Canada are J. W. Pyke & Co., of 35 St. Francois Xavier St., Montreal.



A number of well known engineers and manufacturers who witnessed the experiment, expressed their confidence in the success of the process, and it is the intention of Messrs. Pyke & Co. to put the new process on the Canadian market by either leasing the machines on royalty to users or selling the rights to manufacture the machine. They are open to negotiate with responsible parties to this end.

LITERARY NOTICES.

The National Brick Manufacturers' Association of the United States appointed a commission in February, 1895, to make such tests of paving brick as could be used as standards. This commission has now reported in a pamphlet of 110 pages, containing 34 tables of tests and a large number of diagrams, of great importance to every engineer who has to deal with the brick-paving problem. These tests and calculations are issued as being thoroughly reliable, the committee having in view especially the establishment of standard tests that would prove ample for municipal authorities.

Those who have read the book "In the Days of the Canada Company," by the Misses Robina and Kathleen M. Lizars, will be keen to read any fresh contributions from the same source, and when a new book was announced the other day dealing with the rebellion times in Canada, there were confident anticipations of a good treat. The book has appeared and our anticipations have been realized. "The Humors of '37," is not an ill-chosen title as might at first sight appear, for taking the word humor in a broad sense we have in this a judicious and appetizing mixture of "the grave, the gay, and the grim." We should expect in a book on this subject plenty of the grave and grim, but we do not always associate gaiety with treason, though fun is often tumultuous. In this work of 369 pages, the reader will, however, find instruction and amusement combined with a tact and instinct possessed by few writers. To the old, the "Humors of '37" will recall many a scene of those exciting days, while to the young it will give much solid information in an entertaining garb relating to a great crisis in Canadian history. The book is published by Wm. Briggs, Toronto, and like all the recent publications from this house is excellently printed.

Undoubtedly the book of the year on South Africa is that written by Poultney Bigelow, at the request of Harper Bros., New York, by whom it is published. It was fortunate for the author that he had written his other interesting book, the "History of the German Struggle for Liberty," before his visit to South Africa, instead of after, for he had thus opportunities of comparing German official methods with British methods in relation to the Dark Continent, and while he writes with an American's prejudice in favor of the republican form of government, and is most enthusiastic in his admiration of President Steyn, of the Orange Free State, and Paul Kruger, of the Transvaal —to the former he dedicates the book—he gives enough light on German and Hollander official character to show the Boers what their fate would be if they fell under control of those countries. Our author admits that the surrender of the Transvaal to the Boers in 1881, though magnanimous, was a mistake. "The Boer Government to-day is applying to a complex modern community administrative principles fit only for a community of cattle herders and teamsters." The recent agitation which led to the Jameson raid "was not an English rebellion against Dutch domination, but a union of Americans, Afrikanders, English—in short every white man who was not an official of the Boer Government, was heartily in favor of a reform in the Government." The Boers confessed their incapacity for governing a modern State by enacting that revenue was to be raised by selling monopolies. "The political economy of Spain in the days of Philip II. was applied by Paul Kruger of 1896 to a community of the most modern and progressive manufacturers ever assembled together in one spot."

The convention number of the *Street Railway Journal*, of New York, is a splendid monument of enterprise in American trade journalism. This number contains 361 pages, of which 133 pages are reading matter. The advertising pages are quite as interesting as much of the reading matter, and large sums of money must have been spent by various manufacturers on designs for their advertisements. Each copy of the paper weighed 4 lbs., and the postage abroad was 32 cents for a single number.

"Across the Sub-Arctics of Canada" is the title of a very important contribution to our scanty knowledge of our great northern regions about Hudson Bay, by J. W. Tyrrell, C.E., of Hamilton, brother of J. B. Tyrrell, of the Geological Survey. It is an instructive account of a journey of 3,200 miles by canoe and snowshoe through the "Barren Lands" to the west of Hudson Bay, undertaken by the author and his brother in 1893. The expedition left the railway at Edmonton, N.W.T., and descending the Athabasca River to Athabasca Lake took its way by the chain of lakes and rivers to Chesterfield Inlet, thence coasting along Hudson Bay to Fort Churchill and York Factory, and from there through the forest down to Lake Winnipeg, and home *via* Winnipeg. Mr. Tyrrell treats of the customs and habits of the Indians and Eskimos met with, the game, fish and economic animals, the timber, minerals, etc., and gives much information on the geography, botany, geology and general natural features of the country traversed. Maps and numerous illustrations add interest to the work, which makes 280 pages, and a valuable appendix gives a catalogue of plants collected on the trip, while another appendix contains a vocabulary of Eskimo words and phrases. We hope to give a more extended notice of this book, and meantime commend it to all who would learn more of our great heritage in the north. Published by Wm. Briggs, Richmond street west, Toronto.

The December issue of *Power*, New York, is an international number, and its table of contents is printed in German, Spanish, French and English. The leading article is a description of the proposed power station for the Metropolitan Street Railway Co, New York

"Power Catechism," being correct answers to direct questions covering the main principles of steam engineering and the transmission of power, has just been issued by the publishers of our able contemporary, *Power*, of New York. There are 735 questions answered, followed by tables from which various calculations can be made by the steam engineer, the whole making 226 pages, illustrated by numerous diagrams. Price $2.

Those interested in bicycles who wish to study the theory of what constitutes a perfect bicycle bearing should get the new catalogue issued by the Canadian Typograph Company, Windsor, Ont., manufacturers of the celebrated "E. & D." bicycle. The illustrations are very clear, and the catalogue is worth studying for its lucid explanations of the mechanical points of the bearing.

E. Leonard & Sons, engine and boiler manufacturers, London, Ont., have just issued a new catalogue (No. 30), containing 44 pages of matter showing some of their best types of engines and boilers. This Company manufacture the Leonard-Ball automatic cross compound engine, and Leonard-Ball tandem compound automatic engine, and simple automatic engine. They also manufacture the Leonard-Tangye engine, which is made in sizes from 50 to 200 h.p., and the Leonard-Clipper engine, which is a new type made in 7 sizes from 15 to 50 h.p. The catalogue gives a bird's eye view of the large works of the Company, and a few interesting facts of the history of the firm, which began business as far back as 1834, its London history dating from 1838. The catalogue will be mailed to anyone interested.

The Industrial Publication Co. of New York, have issued the first number of a series of handy books on mechanical subjects. The first issue treats of elementary principles of machine design as applied to steam engines, and is edited by J. G. A. Meyer, author of "Modern Locomotive Construction." It contains 92 pages and has a number of very clear diagrams and illustrations. The price is only 25 cents.

"The Year Book of the Society of Engineers of the University of Minnesota," at Minneapolis, makes a large pamphlet of 140 pages, and contains papers on nineteen different topics, some of which are very well treated.

The W. J. Johnston Co., 253 Broadway, New York, are to be congratulated on the enterprise shown in the compilation of their "Electrical and Street Railway Directory" of the United States and Canada. It is the only work of its kind in America, and gives a list of all the central lighting stations, electric, horse and cable street railways, telegraph companies, district messenger companies, telephone companies, mining plants and as full a list of the isolated electric plants as one could expect to find. It also contains a list of manufacturers of and dealers in electrical and street railway apparatus and electrical supplies In each department it gives a number of particulars showing the capacity of the plant, the capital employed, the officers of the company and other information bespeaking great care and labor in the compilation. The issue of 1897 makes a volume of 752 pages, and is substantially bound in cloth. Price, $5.

The American Machinist Publishing Co. has issued a neat linen covered volume of some hundred pages, "American and Other Machinery Abroad," which gives in an interesting way the history of the United States trade in Europe in machinery, and a host of facts as to its present position, as well as data upon which a prediction of the future may be founded.

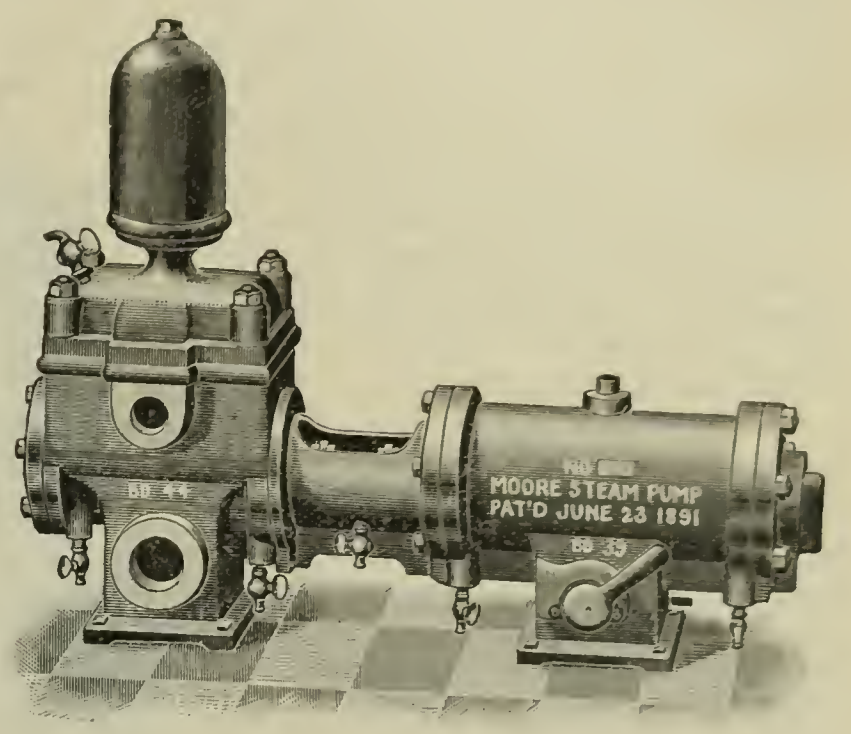
CALENDARS.

THE CANADIAN ENGINEER acknowledges with thanks the receipt of calendars from Morton, Phillips & Co., mfg. stationers; D. K. McLaren, agent for belting and mill supplies, 24 Victoria street; the Queen Insurance Co., the Alliance Assurance Co., the Insurance Co. of North America, the Northern Assurance Co., all of Montreal. The Conger Coal Co. (Toronto) calendar is one of the most up-to-date which we have seen. The view of Dawson City which adorns it is a very cooling sight indeed, as well as an artistic decoration. The Packard Electric Company, St. Catharines, Ont., wishes its friends a happy new year on its monthly blotting pad for January. A. B. Jardine & Co., Hespeler, Ont , have sent out a neat calendar, showing a picture of the village blacksmith, whose opinion is that "it pays to use the best tools." The B. Greening Wire Co., Hamilton, have repeated their famous historical calendar of last year, which shows the three generations of the proprietors, and a fine view of the Hamilton, Ont., works.

THE MOORE STEAM AND VACUUM PUMPS.

The steam valve is placed on the body part of the piston, within the steam cylinder, with heads provided with suitable metal packing rings. Within the body of the piston are the steam ports, leading to each end of the cylinder, and registering alternately with the annular grooves or the valves in its actuation. The longitudinal sliding motion of the valve on its seat, is limited between the piston heads. The valve being carried on its reciprocation by the piston, until its head passes the steam inlet port in centre of steam cylinder, thus admitting steam between the valve head and piston head and forcing the valve against the opposite piston head; changing the relation between the annular grooves in the valve and steam ports in the piston, causing a reverse motion of the piston, and exhausting its steam into the centre of the piston, thence through the hollow piston rod into exhaust chamber between the stuffing boxes. By reason of the two steam ports in the valve seat being of different areas, the piston recedes gradually for a moment and then completes its stroke.

Its simplicity of construction, its small number of parts, its large wearing surface for the valve, together with its positive value motion, with no possible chance of its becoming balanced on its centre, through leakage or other causes, make it, the makers claim, the most desirable pump on the market.



By the method used in restricting the exhaust steam with the slow start and steam cushion for the piston, the speed of the pump is automatically regulated. Never running too fast to take suction, or fast enough to injure its working parts should the water supply give out, it can be regulated to supply water in the boiler to a uniform height without attention.

As it will work with a lower steam pressure than an injector, or most steam pumps, the boiler can be filled after stopping the engine, without an extra fire. As a boiler feeder this pump has no equal. It is made to couple on either right or left. With the working parts entirely closed, it can be set up in the most convenient place without fear of any damage from grit or dust. The stuffing boxes being enclosed in the exhaust chamber, there is no drip or escaping steam into the room, and by means of the lever on the front side of the pump, the exhaust steam and all drippings from the stuffing boxes can be thrown into the suction chamber to warm the water, and is then returned to the boiler.

This pump, the maker believes, avoids the sensitive qualities found in other pumps for similar purposes. Starts promptly and will clear itself. No skilled engineer necessary to operate it. This pump heats water to a degree of temperature higher than any other pump on the market. These pumps are built by an old established and responsible firm, and are guaranteed to be perfect in material and workmanship. They have had thorough and practical tests by experienced engineers, who unite in speaking in the highest terms of it. Darling Brothers, Reliance Works, Montreal, are the Canadian agents of the Moore Steam Pump.

ARC LAMPS FOR CONSTANT POTENTIAL.

The Canadian General Electric Co., Limited, announces that it is prepared to furnish a satisfactory and economical arc lamp for constant potential, alternating current circuits. The problem has been a difficult one to solve, but the results obtained have, the company claims, warranted any apparent delay.

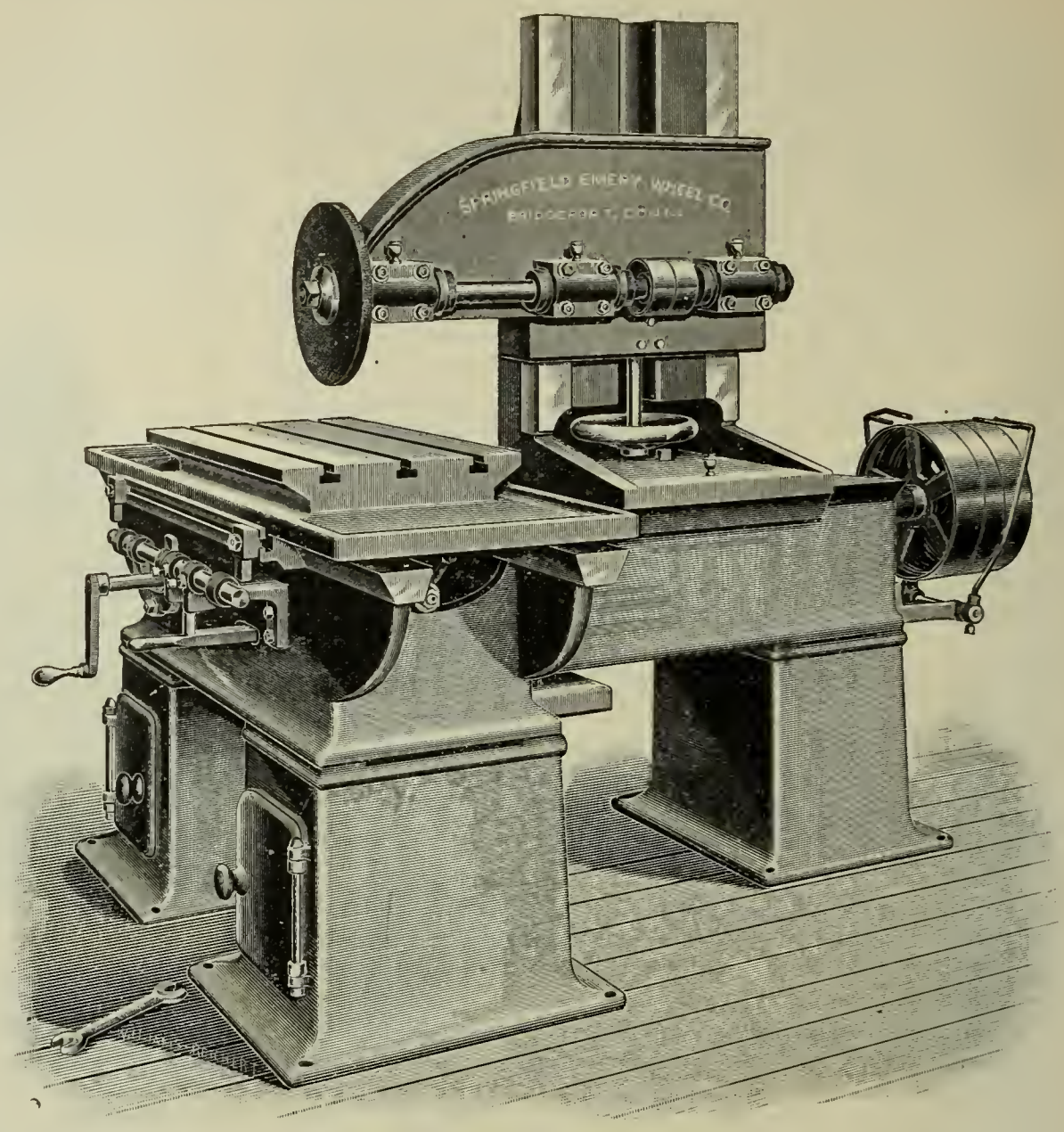
The principal features of the new lamp are briefly as follows: Small maintenance account, by reason of a life of 60 to 70 hours, with one pair of carbons. The lamp is simple in construction, has few moving parts and operates quietly. Great economy. Ninety-three per cent. of the energy is utilized in the arc. Operates independently on circuits of 100 to 120 volts, and frequencies of 60 or 125 cycles. The lamp requires 70 volts potential at the arc, and consumes 6 amperes. The difference in the potential at the arc and at the terminals is taken up by an inductive resistance, which is the unique feature of the lamp. This inductive coil does not consume in excess of 25 watts, and is placed within the interior of the ornamentation. The use of high grade carbons is essential.

The lamp is artistic in appearance and especially suitable for interior illumination. The ornamentation is finished in ground brass and black enamel.

OPEN SIDE SURFACE GRINDER.

The accompanying cut represents a 2 ft. open-side surface grinder, a practical machine for surfacing flat surfaces up to 16 inches in width and 24 inches long, and will admit work 12 inches in under the emery wheel. The machine is fully automatic; the carriage is driven by a screw connected by bevel gears to the main shaft of the machine. The emery wheel head, to which the automatic feed is attached, is also driven by a screw, the end of which is shown with a crank attached on the front of the machine, which can be operated by hand or automatically as desired. These machines are made to take in work of different lengths from 24 inches to 144 inches.

For further particulars address the Springfield Manufacturing Co, Bridgeport, Conn., which also manufactures a large line of different varieties of surface grinders.



OPEN SIDE SURFACE GRINDER.

PLUMBING.

Editor THE CANADIAN ENGINEER.

SIR,—I have read with pleasure the letter on sewage ventilation on page 238 of December number, and the three able articles on the disposal of sewage and sewage ventilation in your issues of April, September and November, and can bear out the remarks of "Constant Reader" by relating facts that have come to my notice, proving that the sanitary by-laws at present in force in Toronto, are made and enforced for the benefit of the officials more than to improve the public health.

At No. 243 Church st. there is a blacksmith's shoeing shop. At the rear end, on the line of Dalhousie st., stood an old dwelling house with a Philadelphia Hopper Water Closet. This house was pulled down to give yard room and more light, and an outside pit closet was built in yard with all new standard material, and the old closet and pipes were discarded. The position of the new w.c. was four yards northwest of the former position, but on the line of the same drain pipe, which had to be cut and shortened and one full W. Y. junction, one bend and one length of pipe connected to it to receive the soil and rain water pipes. This old 6-inch drain continued from the yard under the smith forge to Church st., about 70 feet, and connected with the street drain very properly, without the catch bag or running trap, as it is called, and stink pipe, usually termed the breather. The inspector demanded that the drain should be broken at the Church street line, and a trap and breather put in, which was done at a cost of about $15, the depth being nearly 13 feet. When he came to inspect, he found the work had been completed in a first-class, workmanlike manner, but his pocket level showed that the drain fell slightly the wrong way just at this point; but on digging down at rear end of shop, it proved that in the 70 feet length of smith's shop the drain rose four feet, or if a regular grade was given, it would be over ¾ inch to the foot, and as only three lengths of pipe was bared, it did not prove anything, because a sensible drain layer will keep the drain down at the delivery end, and rise at beginning end to give the flow a good start. However, the inspector ordered that the old drain should be bared, which he himself could see could not be done without removing the smiths' fires, bellows and anvils, lifting floor and digging at a 12 ft. depth.

It was rather remarkable that the diggers' pocket level showed the three pipes to be about level, with an inclination of fall towards the street: so also did a carpenter's level, and it puzzled a few why the inspector's level showed the fall to the contrary way.

The owner of the property saw that he could not easily please the man with unlimited powers, so he paid the city nearly $14 to put in a drain from Dalhousie street, and from the street line to pit w.c. in yard, put in a heavy cast iron drain pipe with local joints.

The weather at the time was at or below zero, and the embankment of drain very dangerous, and the pipe-fitter made a written application for inspection and smoke test under the clause, which relates "That when soil is dangerous the inspection shall be made forthwith, and when the water test is not safe by reason of frost such test shall not be used." See by-law XI., page 11.

After waiting four hours a boy was sent to see when the inspector would please to come, returned with the order to fill the frozen pipes with water, and he would come and see them. This meant having them filled with ice and the destruction of the rubber plugs and iron traps that could not have been again emptied, before they became solid.

These facts prove that an unnecessary expense of about $100.00 and a troublesome delay and annoyance of several weeks, was given by this city official and by-laws, to secure an outside privy to accommodate five working smiths, though every foot of drain under the smithy floor, was, where seen, first-class in material and workmanship, and covered with about seven feet water-tight stiff clay, that would not let sewer gas penetrate.

Query: Is it the public or the public servants that secure the advantages of the public health by-laws in this case. Let us cite a case to show a contrast:

There are three houses in the West End, that are drained on the rule of thumb principle without proper judgment. Some months since, the agent for owners asked a plumber if he would put water closets in each house at a very low price, which he named. The plumber replied that he could not, because the drains were not right and would be condemned by the inspector, and the money offered would barely cover cost of plumbing material required, and labor, and the cost of $10 in which the waiting for inspector to come, and getting the work passed was not included. This agent showed that he had a pull, and that no inspector or official would interfere, and he undertook to secure the plumber from any blame or expense on that account, if he, the plumber, would do the job at his price. The bargain was closed, the water closets put in, the old rotten drains patched up the easiest way to make them take the stuff, and everything done openly without interference from any city official, though the inspector did visit his friend while the work was going on, in the evening, and looked through the work.

This sort of city officialism is common enough, and openly enough done; but the council will not notice it, except the parties pinched have another pull with them. Respectfully yours,

H. L. MCKINSTRY.

150 Victoria St.,
Toronto, Dec. 27th, 1897.

APPLICATION for a charter is made to the Ontario Legislature for the Smith's Falls Rideau & Southern Electric Railway Company to construct electric railways, the principal lines being within Smith's Falls, with extensions to Lombardy, Oliver's Ferry, Portland, and to Rideau Lake, Harlem, Chantry, Frankville, Toledo, Newbliss, Merrickville, Burritt's Rapids, Oxford Mills, Bishop's Mills, Easton's Corners, Irish Creek and other points within the said counties of Lanark, Leeds, and Grenville.

TO SEE IT IS TO APPRECIATE IT.

MIKADO GOLD MINING CO., LIMITED, HEAD OFFICES, LONDON, ENG.

BIGGAR, SAMUEL & CO., MONTREAL :

DEAR SIRS,—I have just been handed a copy of your worthy paper, THE CANADIAN ENGINEER, and finding it so full of bright and useful reading, I have concluded to subscribe for it at once. So you will please find one dollar enclosed for same.

I remain, yours truly,

GEORGE W. MCKENZIE.

Rat Portage, Ont., December 17, 1897.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The twelfth annual meeting of this society is to be held on Tuesday, 11th inst. According to present arrangements, the meeting will be called to order at 9.30 a.m., on Tuesday, under the presidency of T. C. Keefer, C.M.G. After reading the minutes, the scrutineers will be appointed for the election of officers. Through the courtesy of the C P.R. and the G.T.R. a special train will start at 11 o'clock for Chambly, to enable the civil engineers to view the works of the Royal Electric Co. at that place, and afterwards to enjoy an entertainment at the hands of the Electric Co. On Wednesday, at 10 o'clock a.m., the society will receive the reports of the outgoing council and address themselves to the transaction of general business.

HENRY HOLGATE, C.E.

The prominence that is now being achieved by Canadian electricians has received another exemplification in the selection of Henry Holgate, C.E., of Montreal, as manager of the new West India Electric Co., of

HENRY HOLGATE, C.E.

Jamaica. Mr. Holgate will go to Kingston, Jamaica, about the first of February, where he will superintend the erection of about 25 miles of railway, which will probably be extended later on. Henry Holgate was born in Milton, Ont., in 1863, and served his apprenticeship with the Northern Railway of Canada. He became chief engineer of the combined Northern and North-Western Railways, which were merged into the Grand Trunk in Feb., 1888. He continued as chief engineer of this division under the Grand Trunk till 1892, when he took charge of the Central Bridge and Engineering Co., of Peterboro, as engineer for a year, during which the steel work of the new Union Station at Toronto was constructed. He came to Montreal in June, 1894, as engineer for the Royal Electric Co., and built and equipped the new factory. The directors of the Royal Electric Co. being interested in the Montreal Park and Island Railway, he was transferred to the latter company in June, 1895, where he remained in charge of operation and construction to the present time. We hope the readers of THE CANADIAN ENGINEER may hear from Mr. Holgate in his new field of operations.

ELEVATORS: ELECTRIC VS. HYDRAULIC.

Editor CANADIAN ENGINEER :

SIR,—I trust you will allow me to reply to the discussion by Mr. Philip, in the December issue of THE CANADIAN ENGINEER, of the comparative merits of electric and hydraulic elevators for the city hall of Toronto. It would seem probable that Mr. Phillip has more knowledge of the operation of hydraulic than he has of electric elevators. The comparisons and statements made by him are open to serious question, and as his opinions may have weight with the readers of your valuable paper, I will state briefly my reasons for disagreeing with some of his conclusions. His divisions of first cost, safety, reliability, economy and cost of maintenance will be followed.

Cost.—The first cost of the electric elevator plant was $30,000, and the cost of an extra high speed engine, dynamo, incidental apparatus and piping to run such elevator would be less than $5 000—total cost of $35,000, or $10,500 less than the bid of the lowest hydraulic elevator company, If the lighting engines were merely enlarged to meet the wants of the elevators, the difference will be still larger.

Safety.—Again I must take exception to Mr. Philip's statements. The electric elevator is safer than the hydraulic; in addition to the mechanical safety devices of the latter, there are independent electric safety appliances, which not only prevent actual drop, but prohibit unsafe increase in speed. Of still greater importance is the condition that the tendency of the electric machine is toward safety, that is, leaks, short circuits or trouble of any kind tends to remove power and prevent motion, while in the hydraulic elevator the tendency is exactly opposite, a leak or a break meaning movement in one direction or the other. This is clearly shown in the familiar "creeping" of the hydraulic elevator due to air in the cylinders or leaks of one kind or another; yearly there are several deaths due to this cause.

Neither is there an elaborate "cycle of changes" in applying power. Current is applied to a solenoid, causing a switch to close the motor circuit, and gradually cut out resistance to the current flow. To stop the car, the auxiliary current is cut off by releasing a push button and all switches open; the car then stops, due to the nature of the worm gear, and in some cases to the use of an auxiliary brake thrown on mechanically, or by closing the motor circuit on itself, causing the car to do work and slow up. Hence there is no power "used to stop the car as well as to start and run it."

Reliability.—The machinery of an electric elevator does not appear complicated—it is in use in hundreds of New York buildings and receives the least possible care and attention; it is practically the simplest method of hoisting a weight, similar in some respects to the hod hoists, and consists of a drum around which the hoisting and counterweight ropes wind, the drum being driven by worm gear and electric motor. The comparative wear and tear of the two types is yet to be determined. So far electric elevators have not shown signs of wearing out, but taking the generating machinery into consideration, their life is probably less than that of hydraulic pump and cylinder. The difference is not of great moment.

Economy.—Here I must absolutely contradict Mr. Philip. His contention that a plant of underbalanced hydraulic elevators is more economical than a plant of overbalanced electric elevators is totally at variance with both theory and practice. He states that the pump does an average amount of work continually. This is not quite true, as the size of the pressure tank for such a condition must be abnormal, but for purposes of discussion it may be taken as a fact. But even so, the "average" work done is not the "average" work of the electric elevator plant. In the first case, as the work is the same irrespective of the load lifted, it is the average of the maximum capacities of the elevators plus one-third of the weight of the unloaded cars. In the second case the work done is merely that due to lifting the difference between the actual live load and the average load, and this is reduced by the return of current to the source of supply by the descending elevators. Figures taken from about twenty elevator plants of this type in New York city show from 1.7 to 2.5 kilowatt hours per car mile, with speeds varying from 250 to 400 feet per minute, capacities from 1,500 to 3,000 pounds and cars from 20 to 30 square feet area. The coal per kilowatt hour in one of these buildings was from 4 pounds in summer to 5⅓ pounds in winter, using simple Corliss engines direct connected to electric generators, while another building with high speed simple engines and long lines of piping required from 8 to 9 pounds. The car miles per day varied from 10 to 22, depending on the speed. Taking an average of 16 miles and 2.1-k.w. hours per car mile, the coal per car per day, in an electric plant where light is also supplied, is from 135 to 300 pounds, depending on the type of engine and heating conditions. Two hydraulic elevators operated by compound pumps, under the best conditions, in a fire insurance building in New York, use 1,000 pounds of coal per day, while with a simple pump in the same building they used 1,500 or from 500 to 750 pounds per car per day. Where expensive high duty pumps are employed the test of the American Tract Society elevators by Charles E. Emery, Ph.D., shows the coal per mile to be over 28.8 pounds, or 461 pounds for 16 car miles under test conditions. These cars were built for high speed and are not of course to be compared with the elevators in question, but it is safe to say that electric overbalanced worm-gear elevators will not and do not use over three-fifths the coal per car mile in ordinary conditions, that would be and is required for hydraulic operation, and the proportion will generally be less.

It is not necessary to have a plant of rated capacity equal to that of all the elevator motors, though Mr Philip appears so to believe. Its rated capacity need not be more than is required for starting two elevators and running the other two (if there are four installed), as all engines and generators are built now-a-days with an excess momentary

capacity of from 50 to 100 per cent. Nor is there any short circuit of the motor on starting—as in all types of electric elevators variable resistance is inserted at starting between the generator and motor. I am sorry not to be able to coincide in my views as to storage batteries with those expressed by Mr. Philip. They seem to me to have decidedly passed the experimental stage and have become a recognized part of the modern building plant installation where economy is obtainable by their use. Whether they would be advisable for the city hall is quite another question.

It may be of interest also to state that the Edison Illuminating Company of New York does not consider "electric elevators a curse to a lighting station." They have installed one in their building as an object lesson and advocate their use as much as possible.

In conclusion I am glad to be able to agree with Mr. Philip as to the advisability of installing an isolated plant. In general, with a building as large as the city hall, a private plant will prove highly economical provided it is managed as it would be by a private corporation.

Very truly yours,

PERCIVAL ROBERT MOSES,
Consulting Electrical Engineer.

35 Nassau St., New York,
December 27th, 1897.

STEEL RAIL HIGHWAY PROPOSED BY THE U. S. DEPARTMENT OF AGRICULTURE.

Complete designs for wagon roads, with steel trackways, have been prepared by Gen. Roy Stone, Director Office of Road Inquiry, U. S. Department of Agriculture. As many of our readers know says the *Engineering News*, the Agricultural Department has given much attention to the subject of good roads and has organized the office of Road Inquiry to foster highway improvement and experiment with different systems of country road construction. Through the efforts of this office a model macadam road has been built at New Brunswick, N.J., and a combination macadam and dirt road, 7,000 feet long, at Geneva, N.Y. The road at Geneva has a centre of macadam 8 feet wide, with rolled dirt roadways on each side. These samples of road construction are designed to be object lessons in the economy of good material and construction for country roads.

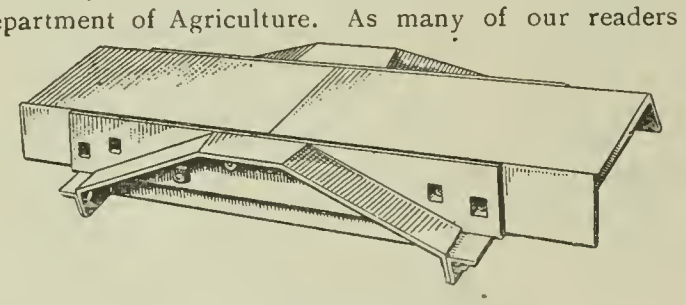


FIG. 2.—PERSPECTIVE VIEW OF RAIL JOINT FOR STEEL RAIL HIGHWAY.

The possible advantages of combining a steel trackway for wagons with the broken stone centre, has led the Office of Road Inquiry to investigate the subject with the idea of building an experimental road of this kind. This study has resulted in the design of the steel rail highway which is illustrated in the accompanying cuts. Fig. 1 is a cross-section of the completed road, showing the arrangement of the steel rails and stone filling, and the nature of the drainage system. Fig. 2 is a perspective view of the rail joints, and Fig. 3 is a transverse section of the same joint.

FIG. 1.—CROSS-SECTION OF STEEL RAIL HIGHWAY, DESIGNED BY THE OFFICE OF ROAD INQUIRY, U. S. DEPARTMENT OF AGRICULTURE.

As will be seen from the illustrations, the general idea is to lay two parallel lines of steel rails, supported by a broken stone filling. These rails have an inverted trough section, the top of which forms the track for the wheel, and is 8 inches wide, with a slightly raised bend on the inside edge to guide the wheel. The thickness of the top of the section which forms the track is about 7-16 inch, and the total weight of the steel and connections is about 100 tons per mile of single track. The rails will be connected transversely at intervals to prevent spreading, but there will be no cross ties, the broken stone ballast alone supporting the rail.

The construction at the joints is shown by Figs. 2 and 3. An inverted trough, Section A, forms the basis of the joint support. Over this trough are slipped the two ends of the track rails, B B, which meet in a butt-joint at the centre. To each side of the track rails are attached the remounting devices, C C, connected at the ends by the transverse angles, D D. These three principal parts which make up the joint are firmly bolted together, as shown by the drawings. The object of the remounting device is, of course, to enable heavy wagons, which have left the rails, to be easily returned to the track by mounting the inclined shoulder at the rail joints.

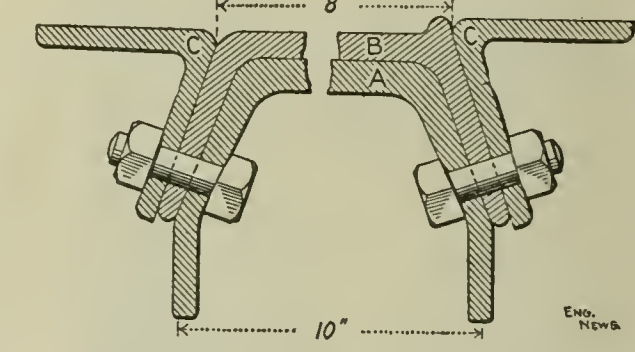


FIG. 3.—TRANSVERSE SECTION OF RAIL JOINT FOR STEEL RAIL HIGHWAY.

Arrangements have been made with the Cambria Iron Co., of Johnstown, Pa., to roll these track rails, the arrangement to go into effect as soon as definite orders for an aggregate of one mile of road are obtained. It is estimated that the cost of rails and joints for one mile of road in the United States will be $3,500. As indicating the possible utility of steel rail highways, Mr. Stone has obtained information regarding two previous experiments with steel rails on wagon roads, and has furnished us copies of the letters from the builders, which describe the construction and operation. The first letter is from F. Melber, engineer and contractor, Standard Building, Pittsburg, Pa., and is, in substance, as follows:

"My road has been in position for about a month, and, among other interesting things, I watched the temperature of the steel when exposed to the hot afternoon sun. Every steel worker knows that steel bars lying in the yard of a bridge works, for instance, will get so warm in a few minutes that the men cannot hold them in their hands. I find that my steel stringers remain cooler than the adjacent broken stone. This, I think, is a remarkable as well as an important fact, and it goes to show that there takes place an interchange of the temperature between the inner substances and the steel, and that in this class of steel highways we do not need to provide for expansion. Altogether, I find the steel road to verify all I have said about it, even as to cost, and with regard to traction advantages I am now able to give figures. I have made twenty trials, using a gauged spring balance, and find that the average force needed to pull the iron wagon, weighing 1,550 lbs., with a 16-foot wagon-bed, is 2.5 lbs., which, reduced to a load of 2,000 lbs., means a traction force of 3 23 lbs. per ton."

The second letter is from Abel Bliss, of New Lennox, Ill., and is as follows:

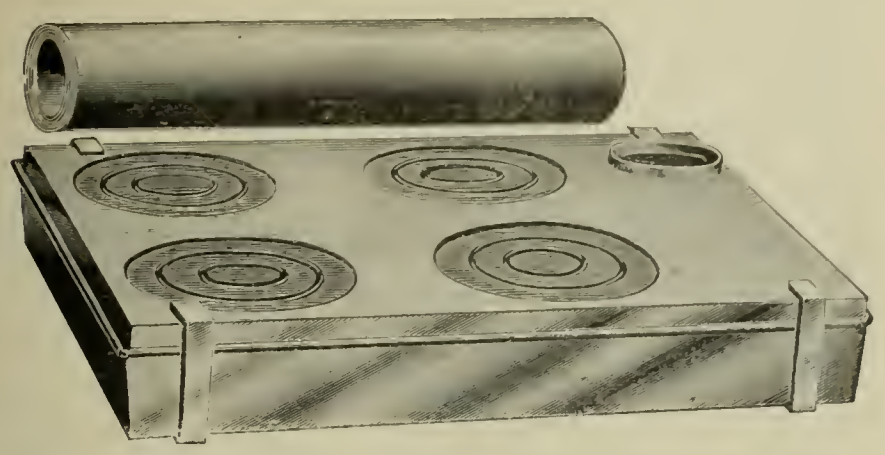
"I take the liberty of giving you my experience with a steel roadway which I placed in the public highway near my home, four miles east of Jolliet, Ill. It was put down April 2, 1896, on a dirt road of typical Illinois soil, and consisted of a steel rail ¼ in. thick and 8 ins. wide, with a flange 3 ins. wide turned down on either side and a ¾-in. flange turned up on the outer edge to keep the wheels on the rails These rails were let into the ground so that the flat part rested on the earth, and were fastened together at the ends by fish plates, which are so constructed as to run the wheels onto the rails after passing a team. The earth between the rails was removed to a depth of four inches, and the space filled with gravel for a tread for the horses. These roads have been tested with all kinds of loads, including traction engines, and have retained their position very well. While the mud made the roads almost impassable here during the winter, a team could have trotted on this roadway any day with a two-ton load. About 50 tons of steel per mile will be required, having the rails ¼ in. thick, which I think is ample."

These experiments are of much interest to Canadians, especially in the neighborhood of large cities where the vehicle traffic is heavy. The added profits which every farmer would make on his produce with such roads as this would be a material factor in the development of the country.

INCORPORATION has been granted to H. S. Griffin, M.D., T. J. Stewart, W. Trusdale, Hamilton, Ont.; J. Dickenson, Glanford, and W. M. German, Welland, Ont., as the Odorless Crematory Closet and General Heating Company of Hamilton, Limited, to manufacture, sell and deal in odorless crematory closets and heating furnaces. Capital, $24,000.

TESLIN STOVES.

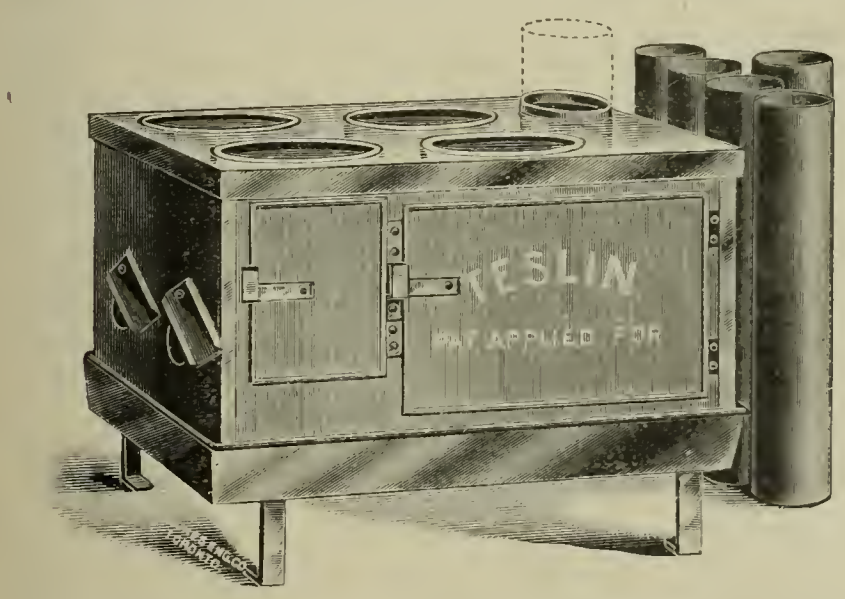
The peculiar conditions of life in the golden north are rapidly bringing into being a number of entirely new appearances to fill new wants, and also old appliances so changed as to be hardly recognizable. The peaceful blanket of our more genial climate has become the fur-lined sleeping bag of the Klondyke, and the kitchen range of the south east built into the chimney and occupying yards of space has become in the far North-West the Teslin stove, which when closed up for car-



STOVE FOLDED UP.

riage occupies a space of 28x22x4 inches, and weighs with 9 feet of pipe only 53 lbs. The following are the dimensions of the Teslin stove when set up:—Size of top, 28x22 inches; height, 13 inches: size of oven, 22x14x9 inches; size of fire-box, 22x9x13 inches; size of fire door, 6x8 inches; size of pipe collar, 5 inches; weight with pipe, 53 pounds.

The method of setting up the stove is simplicity itself. The shipping bands become feet, and by a few easy movements, much as a



cardboard box is opened for use, this stove is set up. An illustrated card giving full instruction of the process of setting up the stove is supplied to purchasers.

This stove has direct as well as indirect draft, and the arrangement of flues direct the heat around the oven for baking as in a high-priced cook stove. The simple construction of the stove renders it perfectly rigid when put together, and the heavy angled corners assist in preventing the stove from warping.

Has four 8¼ inch pot holes on top.

Five lengths of telescopic pipe (supplied with each stove) wil extend to 9½ feet. Also supplied with thimble for tent through which pipe passes.

These stoves are being placed on the market by the McClary Mfg. Co., London, Ont.

The McClary Mfg. Co. is making a specially praiseworthy effort to meet the demands of trade created by the opening up of the northern country, and is issuing a special catalogue giving details o goods adapted to the gold country.

FIRES OF THE MONTH.

Nov. 4th—Macpherson & Co.'s Foundry, Fingal, Ont. Well insured.——Nov. 5th—Sydney Cheese Factory, J. R. Bower, Belleville, Ont., manager. Loss on building, $1,000. To be rebuilt at once.——Nov. 11th.—J. L Pollock's saw mill and electric light plant, Drayton, Ont.——Dec. 2nd.—American Tire Co., King Street, Toronto, Loss, $6,000.——Dec. 17th.—Tate & Bateson's planing mill, Bracebridge, Ont. Loss, $2,000; no insurance.——Dec. 31st.—Kingston General Hospital, Walker's wing. Damage, $10,000.——Jan. 5th.—Ottawa University, east wing. Loss, $50,000.——George W. Reed & Sons, manufacturers of sheet iron and roofing materials, Montreal, three store sheds. Loss, $12,000; cause unknown.——Lancaster Machine Works, Lancaster, Ont., shops partly destroyed on 1st January Loss about $1,000, no insurance; will rebuild at once.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during November, 1896, 1897, and the eleven months to November, 1896-1897.

	Month of Nov.,		Eleven months ending Nov.,	
	1896	1897.	1896	1897.
Hardware and cutlery	£5,734	£5,224	£58,897	£63,717
Pig iron	1,732	2 724	27,936	[illegible]
Bar, etc.	1,190	751	15,239	[illegible]
Railroad	2,525	11	174,434	[illegible]
Hoops, sheets, etc.	4,044	6,562	46,721	[illegible]
Galvanized sheets	7,435	3,620	54,407	52,606
Tin plates	42,731	54 450	153,220	217,421
Cast, wrought, etc., iron	2,912	3,090	47,861	31,979
Old (for re-manufacture)	160	1,201	15,756	7,654
Steel	5,679	4,455	85,548	51,956
Lead	3,076	3,451	16,355	27,401
Tin, unwrought	6,631	2,386	20,208	17,369
Cement	1,735	1,306	32,766	19,797

Mining Matters.

THE mineral exports from Nelson, B.C., during 1897, amounted to 53,971 tons, valued at $7,891,329.

A PLAN is proposed in Kingston, Ont., to open up the lead mines in Frontenac county and have the ore reduced in Kingston.

KOLIN, the clay from which porcelain is made, is said to have been discovered not far from Halifax, N.S., and of the finest quality.

D. A. JONES, Beeton, Ont., reports the find of an extensive area of quartz, rivaling the famous Hammond reef near Wahnapitae, Ont.

THE Le Roi mine has paid its regular monthly dividend of $50,000 in spite of the expense incurred in building the Northport smelter.

ASBESTOS, comparatively a new mining town near Danville, Que., claims to have a population of 1,500, and is seeking incorporation as a village.

A TRACT of sand carrying alluvial gold is reported to have been discovered recently about ten miles from Chatham, Ont., in Raleigh township.

A FIND of platinum is said to have been made about two miles in the interior from Stevenville, St. George's Bay, Newfoundland, by Garret Dalton.

THE galena found on lot 9, con. 4, Calumet Island, Que, has assayed as high as $60 per ton in silver, with traces of gold. The outcrop is about 18 x 40.

THE Ontario Government diamond drill is working on a gold property known as "J. C., 66," a few miles east of Rat Portage, owned by N. B. Eagen, Toronto.

C. RIORDAN and J. R. Barber, Toronto, are promoting a stage line from Edmonton to Dawson, and the construction of a telegraph line. They will organize a company, it is said.

THE black gold-bearing sand which is attracting so much attention in the Saskatchewan is also found in many of the streams in British Columbia, notably in the Kootenay.

THE B.C. mine at Greenwood, B.C., has ordered a complete development plant from the Jenckes Machine Co. Sherbrooke, and work will be pushed on this property this winter.

W. AUSTIN, Cardiff township, Haliburton county, Ontario, reports a find of ore including gold and copper on his farm. Tests are said to show $16.80 in gold and $24 in copper to the ton.

THE New England Gas Company has contracted with the Dominion Coal Company for 100,000 tons of coal to be delivered annually in Boston, with the option of taking 1,500,000 tons.

THE Le Roi Mines, Rossland, B.C., are extending their pumping system, and have placed an order through the Rossland branch of the Jenckes Machine Co., Sherbrooke, Que., for a large size special Knowles Sinking Pump.

THE Virginia Mines, at Rossland, B.C., have passed the preliminary stage and will now enter the list of shippers. An order for a large hoisting plant with boilers has been placed with the Rossland branch of the Jenckes Machine Co., Sherbrooke, and is now on the way from the East.

At Phillip's Arm, B.C., the British Columbia Gold Fields Company has established a trading post.

Jas. Conmee, M.L.A., predicts that in a year and a half there will be 1,000 stamps at work in the Rat Portage district of Ontario.

W. A. Hungerford is going to smelt the gold-bearing ores of Hastings County, it is said, on a small scale near Millbridge, Ont.

Extensive deposits of bituminous coal have been discovered at Dominion City, thirty miles from Winnipeg, at a depth of a hundred feet.

A. E. Hogue, representing a large English company, has recently examined the pay bars on the Saskatchewan River, with a view to putting in gold dredging machinery on a large scale in the spring.

The final clean-up of the Cariboo Hydraulic Mining Co. was made on Nov. 11th. The total yield of the season was $139,000. The water supply was only about half that of last year and the output was very much restricted thereby.

The Fern mines, Hall Siding, Rossland district, B.C., are lighting up the mill and yards, as well as the tunnel of the mine, by electricity, and have placed the order for machinery and apparatus with the Royal Electric Company, Montreal.

A seam of coal found near Sydney, N.S., by E. T. Mosely, will largely increase the coal area of Cape Breton. The seam is known as the Mullins seam, and is six and a half feet wide. It is 14 miles from Sydney, on the Cow Bay road.

The West Vancouver Coal Company, in which H. C. Haliday and other San Francisco capitalists are interested, will, it is said, develop their coal mines at the north end of Vancouver Island and establish a coaling station for Alaska steamers.

A nickel smelter is proposed in Toronto, to cost $500,000. If an export duty were placed on nickel matte, it is thought that capital could be secured to carry on the smelting in Ontario. R. J. Tough is promoting the enterprise in Toronto.

The Ontario Lithographic Stone and Mining Company, Limited, has received an Ontario charter; $250,000 capital. It is to be composed of A. L. Davis, H. S. Macdonald, J. W. Gray, R. M. Dennistoun and F. J. Jameson, Peterboro, Ont.

A. Drolet, manager of the Saskatchewan Gold and Platinum Mining and Dredging Company, has fitted up the Benoit & McKay dredge at Edmonton, N.W.T., at great expense, and it will be used in gold dredging and washing next season.

In the main shaft of the Foley mine, Lake of theWoods district, Ont., which is now being pushed towards the 400 foot level, there is 6½ feet of fine ore in the winze between the 200 and 300 foot levels, and four feet in the drift at the 300 foot level.

The Jenckes Machine Co., Sherbrooke, are furnishing the Canadian Rand Drill Co., Halifax branch, with one of their 20-inch Crocker Special Turbines, to be used in connection with the extensive hoisting plant being installed by the Drill Co. at the Torquay mines.

A. Mackenzie, Montreal, reports that gold is being washed successfully from the Saskatchewan River for 250 miles, the men averaging $1.50 to $4 per day each. About fifty per cent. of the gold is lost owing to its fineness. The bars may be worked over year after year, it is said, and more gold will always be found.

The officials of the Hammond Reef Gold Mining Company have announced the result of their first clean-up. From 259 tons of ore run through the ten-stamp mill five pounds (avoirdupois) of gold were caught on the plates. This is about $5 per ton, and with such a value the Hammond reef is a gigantic proposition, for the deposit is from 50 to 100 feet wide, and the ore can be mined and carried to the stock pile at less than 50 cents per ton.

The bond on the Lynn Creek properties, close to Vancouver, B.C, has been thrown up. The ore is found to contain too much zinc to be profitably worked. This is not the case, however, with copper-gold properties on Texada Island and Phillip's Arm, situated several miles north of Vancouver. Mining companies operating in these sections have shipped thousands of tons of ore as far away as Swansea and with fair results.

It is stated that the New England Gas and Coke Co. will produce from the Nova Scotia coal coke, illuminating and fuel gas, tar and ammonium sulphate—70 per cent. of coke, 10,000 feet of gas, 12½ gallons of tar and 28 pounds of ammonium sulphate to the ton of coal. One half the gas will be used in coking the coal, the rest will be available for the market and may be sold under the pipe line charter at not exceeding 65 cents per 1,000 feet.

Major Hepman, of the Fourth Royal Fusiliers, and Capt. Alleyne, of the Twelfth Lancers, have started from Edmonton for the Klondyke. The party consists of 14 men, including two doctors, besides the packers, drivers, guides, etc. They have 120 horses, a number of dog teams, etc., and expect to put in a number of tons of supplies into Dawson. After reaching Dawson they will survey the country east of the Yukon. Capt. Alleyne is also Reuter's correspondent.

The property of the old Frontenac Lead Mining Co., of Loughboro township, near Kingston, has been bought by some Toronto men who propose to organize and re-open the works under the name of the Frontenac Lead Mining and Smelting Syndicate. The late George Spotswood always contended that, under good management, which the old company never had, this lead mine would pay well, and the new company proposes to put this to the test by putting in a drift below the present workings.

The construction of the new reverberatory and calcining furnaces at the Hall Mines' smelter is being pushed, and it is expected that they will be completed in about two months. The large blast furnace made a run recently which broke the record, turning out 26 tons of matte in 24 hours. Everything is working smoothly and the ore treated continues to be of a very high quality. The management is smelting lead ores from the Slocan in the old 130-ton furnace, which has been converted into a lead furnace.

The Canadian Copper Company, an Ohio concern, and the Anglo-American Iron Company, which control the output of the nickel and copper mines around Sudbury, have special charters domiciling them in Canada on certain conditions, one of which was the establishment of smelting works for the reduction of the ores. It is claimed that in breach of that they have taken their ore to the United States and had it smelted there, and that they have spent in wages and railway freights about $1,250,000 a year in this way outside of Canada. B. B. Osler, Q.C., of Toronto has filed in the Department of Justice, at Ottawa, a petition to the Attorney-General of Canada for leave to bring an action against these companies to revoke their charters.

The Dominion Coal Co., in reply to the criticism regarding the closing of its two collieries at Port Morien and Victoria, states that a new shaft will be opened in a more central part of the coal producing district of Cape Breton. It is stated that the new shaft and equipment will cost $250,000, and two new washing plants will be erected at a cost of $50,000 each. Later on it is intended to build a pocket at Louisburg large enough to hold a ship's cargo of 6,000 tons, with apparatus enabling this quantity to be discharged into a steamer in six hours. For this purpose a new pier will be erected at Louisburg, the outlay at this port being about $250,000. Near Sydney the company is now building a pier to cost $50,000. Altogether the company asserts that it will spend $700,000 in the next two years.

The shipments of ore from Kaslo, B.C., are an indication of the value of the Sandon silver mines. During the month of October, the shipments amounted to 8,450,000 pounds, valued at nearly $400,000. Of this 2,784,110 pounds were lead, and 397,977 ounces silver. The record for the same month in 1895 gave 735,000 pounds of ore, and for 1896 the figures were 1,286,993. The shippers of ore in the Slocan district number over 40, and the mines that are paying dividends number 25. The records show 14 shipping mines for 1895, 39 for 1896 and 53 for 1897, though some of the shippers are not shipping regularly. Returns of ore shipped from the Slocan and sworth mining district, taken from the custom house clearances for the nine months ending September 30th, 1897, show 47,435,000 pounds, valued at $1,853,000, as compared with 23,344,000 pounds, valued at $1,114,000, for the whole twelve months of 1896.

The Calumet galena mines, though owned by men in the neighborhood, is now being worked by a Belgian. The product is a conglomerate of lead and zinc ore containing from seven to twelve per cent. of silver; but about the total wealth of the mine it is at present impossible to form an opinion. The property on Chats Island is that in which Jas. Robertson, of Montreal, is interested. There is an immense deposit of pure galena without any admixture of zinc. It is easily obtained and requires but a small outlay of capital. A recent find has given the proprietors a new impulse, and it is very probable that the mine will be opened up at an early date. Mr. Tough, a well-known owner of mining property in the Sudbury district, also possesses a mine on this same island, containing a deposit of much the same character as that in the aforementioned mine. The extent of this deposit cannot be known till next spring, when the snow has disappeared. The operation of extracting the valuable metal from this ore has been somewhat difficult hitherto, but a new method has recently been discovered in Germany, which will be adopted in the cases of these mines.

A. J. G. Swinney, manager of the Canadian Gold Fields, Limited, Deloro, Ont., told the Toronto *World* recently, that the syndicate has already expended $500,000 in securing control of several square miles of territory, in opening up the same, sinking shafts, installing machinery, etc. With this as a beginning, the company will not cease their outlay

until the mines have attained a producing capacity of $5,000 or $6,000 per day. The underground work done on the property at present consists of two shafts, located a mile or so east of the reduction plant at Marmora Station, on the Central Ontario Railway, but four additional shafts are forthwith to be sunk—two near the old shafts, and the other two a mile to the north and a mile to the south thereof respectively. In order to carry on this work expeditiously, Mr. Swinney has arranged for the immediate installation of a twenty-drill air compressor. And when, with this extensive mining plant, a big ore reserve has been obtained, the capacity of the bromo-cyanogen mill will be increased, so that it will treat 400 tons per diem. Mr. Swinney says that the mispickel averages $15 per ton in gold, and that the new process saves 85 per cent., or over $12 of this. This means, as stated above, that the enlarged mill should turn out between $5,000 and $6,000 in bullion each day. It is also learned that the same money that is invested at Deloro is behind the re-opening of the Belmont gold mines, located nine miles to the northwest of Marmora Village, and formerly owned by A. W. Carscallen, M.P. The Belmont ore is concentrating, and a stamp mill is being erected upon the property.

Electric Flashes.

WALTER MCFARLANE is putting the electric light into his factory at St. Mary's, Ont.

THE Carleton Place council threw out the by-law to grant a bonus to the Lanark County Electric Railway Co.

THE Canadian General Electric Company has installed an isolated plant for A. & J. Clarke, Bullocks Corners, Ont.

THE Cardinal, Ont., starch works is putting in an electric light plant of sufficient power to furnish the works and the town with light.

ENGINEER CHURCHILL, of the S.S. "Iceland," is now in charge of the electric light station, St. John's, Nfld., in place of J. Hepson, resigned.

THE Pontiac Telephone Co. is putting telephones in each of the stations along the line of the P.P.J. Railway from Quyon, Que., westwards.

THE town council of Parrsboro, N.S., has been authorized to spend $8,000 in equipping an electric light plant, to be the property of the municipality.

ST. THOMAS, ONT., has voted to guarantee $50,000 of the bonds of the new electric street railway company, and to pay the first year's interest on them.

THE Windsor Plaster Co., Windsor, N.S., is lighting its works by electricity, and has given the order for the electrical equipment to the Royal Electric Co.

THE Toronto Electric Motor Co. is now running night and day, and notwithstanding recent enlargement of the works is scarcely able to keep up with orders.

THE Dominion Paper Mills, Kingsey Falls, Que., are installing an electric lighting plant in their new mills, and have placed the contract with the Royal Electric Co.

IT is proposed to extend the Belleville, Ont., Street Railway to Trenton and Tweed, using rails sufficiently heavy to allow of the C.P.R.'s hauling freight over the line.

THE Bell Telephone Co. will shortly put up for its Quebec headquarters a new office building, on the corner of St. John and St. Angele streets, Quebec, at a cost of $15,000.

THE St. Jerome Power and Electric Light Co. has had such success in canvassing for lights that it has changed its order from 1,000 light "S.K.C." machine to one of 1,500 lights capacity.

THE St. Lawrence Power Company is applying to the Quebec Legislature for incorporation, for dealing in water, electric, steam and any other power for lighting, heating and manufacturing.

C. E. SHEDRICK. who has assumed control of the Whitney Electrical Instrument Co., Sherbrooke, Que., has on hand a stock of measuring instruments, laboratory apparatus, X-ray apparatus, etc.

THE British Columbia Iron Works Company, Vancouver, B.C., have placed an order for a 10-kilowatt, direct connected, steel frame, incandescent lighting generator with the Canadian General Electric Company.

THE expenses of the municipal electric light plant of Lachine, Que., in 1897 amounted to $3,282, the lighting being 850 electric lights and 43 arc lamps for the entire town. The receipts for the same year mounted to $3,066.

THE Canadian General Electrical Co has recently installed a 250-light plant in the premises of the Northey Manufacturing Co., Toronto.

THE Seine River, Foley and Fort Frances Railway Company, is applying for an Ontario charter to build a line from Bonheur on the C.P.R., to Sawbill Lake, Fort Frances, etc., and to dispose of surplus electricity for power and other purposes

THE Shipton Electric Co., Danville, Que., has decided to proceed with the extension of the power plant this winter, and has made a contract with the Jenckes Machine Co., Sherbrooke, for a Crocker turbine, horizontally set, with penstock and draft tube complete

THE officers of the Sherbrooke, Que., Street Railway Co. are: President and chief engineer, John W. Burke; directors, Percival W. Clements, Rutland, Vt.; Edgar Harding, Boston; Walter Blue, Wm. Morris, Sherbrooke; superintendent L. E. Whitehead, secretary, F. J. Griffith.

BOBCAYGEON, ONT., has a scheme to secure electric railway communication with Peterboro. The proposal is to build a line to Scott's mills, some twelve miles east, then south to Buckhorn, and on to Peterboro. It has been estimated that the line can be built for less than $200,000.

THE Edmonton Electric Light Co., of Edmonton, N.W.T., is improving and extending the plant. The new electrical equipment bought by them from the Royal Electric Co., consists of one 75 K.W. "S.K.C." two-phase generator, complete, with exciter and switchboard, as well as the necessary material for the other changes.

THE Canadian General Electric Company has recently closed a contract with the Bushnell Oil Company, Sarnia, for a 25-kilowatt direct connected, steel frame, incandescent lighting generator, coupled to an "Ideal" engine. This installation will embody all the latest improvements in direct connected practice, which the Bushnell Company, from its connection with the Standard Oil Company of the United States, has learned to value through their experience there.

THE turning on the power and light in connection with the new municipal electrical lighting plant, at Magog, Que., was made the occasion of a reception given by the Mayor and Councilors in the Opera House. The hall was brilliantly lighted by incandescent lamps, and the whole town turned out. Speeches were made by Mayor Bessette and other councilors and a very pleasant evening was spent. Magog is one of the first towns in the Eastern Townships to own and operate its own lighting plant. The power is obtained from the Magog River, a little below the cotton mills. The water wheel plant of the Crocker special type was furnished by the Jenckes Machine Co., Sherbrooke, Que.

THE Canadian General Electric Company is supplying a 1,000 light direct connected, incandescent lighting plant for the Gutta Percha and Rubber Manufacturing Co. This installation will be, when finished, one of the most complete in the country. The machine is of the steel frame, ventilated, armature type, direct connected to an "Ideal" engine, running at the slow speed of 250 revolutions per minute. The great saving in space, durability and high efficiency obtained by the use of these direct connected units has led to their adoption as the standard machine where it is desired to obtain the best and most economical conditions in operating an isolated incandescent lighting plant.

THE Packard Electric Company, Limited, St. Catharines, Ont., announces that it has recently imported from England a sand blast frosting machine, which it is claimed produces frosted lamps far superior to those which have been previously placed upon the market. The effect produced by frosted lamps is appreciated by everyone, but their use in the past has been exceedingly limited, both on account of the inferior class of work in this line, as well as the price charged. The company is also in a position to do any style of fancy frosting, bringing out letters, monograms and any desired design, upon lamps to be used for decorative work. The fine frosting, which this up-to-date machine produces absorbs much less of the light than any ordinary frosted lamp.

THE plant and franchise of the Temple Electric Co., Montreal, have been acquired by the Standard Light and Power Co. The Lachine Rapids Hydraulic and Land Co. have made a contract with this company to supply it with current from the Lachine Rapids and the steam plant will be sold. The Lachine Co. has also closed a contract with the Imperial Electric Co., formerly the St. Jean Baptist Electric Co., to supply it with current, replacing the present steam plant. Although the thermometer has been down below zero this winter, no difficulty has been encountered with frazil ice.

E. RUTHERFORD, electric supplies, Peterboro, Ont., has assigned to R. R. Hall.

M. S. CORNELL, Stanbridge East, Que., is planning to install a lighting plant next spring.

G. C. HINTON & Co., Victoria, B C., are wiring the Jubilee Hospital there, and supplying the fixtures.

JACOB UNLEY has installed an electric lighting plant in New Hamburg, Ont., which is proving satisfactory.

NEIL & KENT, Granby, Que., have placed the contract for lighting their factory with Allen Taylor & Co., Waterloo, Que.

THE C.P.R. Telegraph Company has built a line from New Denver to Nelson *via* Slocan City. This line not only increases the capacity of the Kootenay systems but gives an alternating wire to the main line *via* Revelstoke.

THE Richmond Light and Power Co., Richmond, Que., is adding to its electric lighting equipment, and has placed with the Royal Electric Co., Montreal, an order for a 75 K.W. "S K.C." generator and switchboard complete.

A. H. ST. GERMAIN, North Toronto, is about to organize an autocar service between York Mills and Toronto. He has ordered three electric busses, each capable of carrying 30 passengers, from an English firm and they will be delivered in Toronto before next spring.

A COMPANY has been formed to build an electric railway between St. Catharines and Port Dalhousie. H. D. Symmes, manager of the St. Catharines and Thorold Railway, has let the contract for the cars required for the new line, and will shortly let contracts for four miles of rails, 9,500 ties and 300 poles, wire and bonding, also a 100 k.w. railway generator and several 35-h p. motors.

THE Stevens Manufacturing Co., of London, Ont., has put in dynamos for a 500-light plant for Walter Steward, Lucknow, Ont., who will supply the village with electric light. The same company has put in a 300-light plant for the village of Glencoe. The wiring in connection with these two contracts has been done by the Rogers Electric Co., of London.

THE proposed Smith's Falls Rideau and Southern Electric Railway is to be in the town of Smith's Falls, Ont., with extensions to Lombardy, Oliver's Ferry, Portland, and to Rideau Lake, Harlem, Chantry, Frankville, Toledo, Newbliss, Merrickville, Burritt's Rapids, Oxford Mills, Bishop's Mills, Easton's Corners, Irish Creek and other points within the counties of Leeds. Lanark and Grenville.

THE Toronto and York Radial Railway Company applies to the Ontario Legislature for a charter to amalgamate the Toronto and Scarborough Electric Railway, Light and Power Company, Limited; the Toronto Belt Line Railway Company; the Metropolitan Street Railway Company of Toronto; the Toronto and Mimico Electric Railway and Light Company; the Toronto Suburban Street Railway Company, Limited.

THOS. L. KAY, the well known electrician, formerly of the Kay Electrical Manufacturing Co., has recently severed connection with that firm, and is now with the Canada Electric Motor Co., who have recently started in Hamilton with good prospects. The following are some of the plants just finished:—John Duff & Son, grocers and butchers, 208 and 210 York Street, Hamilton, a 150-light dynamo with 150 incandescent and one arc light, the whole work done by the Canada Electric Motor Co. A 100-light dynamo with a number of incandescent lights installed at the waterworks of Hamilton. A motor for the St. Catharines Electric Railway. The repair of a 250-horse power generator; 8-h.p. motor for Leitch & Turnbull, elevator; motor for Bradt, grocer; a 10-light dynamo for Lees & Son, bakers, and various others. Mr. Kay is one of the pioneers in the electric business in Canada. He started in a small way on the corner of Bay and Market streets, Hamilton, in 1880, and has been connected with the business ever since. Mr. Kay was the first to exhibit a successful light in Hamilton. There were very few electric lights in Canada when he introduced his light, and now there is hardly a city or town in the Dominion where there is not a machine of his design in use. Mr. Kay has devoted the whole of his attention to electricity, the building of electric machines of all kinds, alternating or direct current dynamos, motors, transformers and all kinds of electric work. Any work entrusted to the Canada Electric Co. will receive Mr. Kay's careful attention. The works of the new company are at 32 and 34 Bay Street North. Mr. Kay has associated with him T. O. Apps, who has had considerable experience in the business department of electrical work. Mr. Apps is secretary-treasurer of the Canada Electric Motor Co.

Railway Matters.

THE G.T.R. recently brought a car load of fruit from Portland, Me., to Hamilton, Ont., 670 miles in 32 hours.

ON the eastern section of the Grand Trunk the old eight-wheel freight engines are being done away with and replaced by ten-wheel engines.

THE Signal Engineer Hodgson, of the G.T.R. engineering department, has completed the work of putting in at Woodstock, Ont., interlocking switches.

IT is the intention of the Canadian Pacific Railway Co. to keep the shops running in Winnipeg all winter, fitting up locomotives and cars for the spring traffic.

A BONUS of $75,000 to the Ottawa and New York Railway, to establish workshops in Ottawa, has been adopted by the property owners by a majority of 928.

SINCE the first of January the Intercolonial Railway, the Prince Edward Island Railway, and the leased lines, are known as the Canadian Government railway system.

THE Quebec Government has refused the $250,000 promised to the Victoria Bridge by the late Government, and also the $250,000 promised the Drummond County Railway.

THE I.C.R. management expect to reduce the number of engines between Halifax and Montreal by half, through the new and improved type recently adopted. The number now in use is twenty.

THE Grand Trunk has received 500 freight cars of 60,000 pounds capacity each, built by the Michigan Car Company, Detroit. Another lot of 500 freight cars are being built in the Canadian shops of the system.

THOS. TOMPKIN, Brockville, has been awarded the contract for the erection of a station for the C.P.R. at Vancouver, B C., also for a number of other buildings for the company in different parts of that Province.

PUBLIC meetings have been held in Toronto, and resolutions passed favoring the building of a railway to James Bay. A great deal was said about aid from the Dominion and Ontario Governments and the Toronto city council, but none of the promoters said what amount of money they were prepared to invest in what would undoubtedly prove a most valuable addition to the Canadian railway system.

THE Nova Scotia Midland Railway Company, composed of Wm Strachan, Jno. Beattie, P. Lyal, D. L. Lockerby, Wm. Mackay, S. H. Holmes, and B. F. Pearson, has signed an agreement with both the Dominion and Nova Scotia Governments, each of which subsidize the road to the extent of $3,200 per mile, for the construction of a railway from Windsor, N.S., to Truro. W. G. Reid, Montreal, has the contract to build the Midland, which is 50 miles in length.

APPLICATION will be made at the next session of Parliament by the Hudson Bay and Pacific Railway Co. for an act of amendment to their charter empowering them to abandon that portion of their projected line extending from Prince Albert to Calgary, and to establish in its stead a branch between Prince Albert and Edmonton, and also to lay out a line from Edmonton to a point on the eastern boundary of the Province of British Columbia.

ONE issue of the *Canada Gazette* contained the following applications for railway schemes in the Yukon and Kootenay countries. The Klondyke Exploration Company of London, Ont., asks for letters patent authorizing them to acquire lands and facilities for mining, smelting and transportation purposes. The applicants are: J. M. McIntyre, St. Thomas; J. A. Moody, London; D. A. McIntyre, St. Thomas; R. H. Marshall, London, and G. M. Fox, London. Molyneau St. John gives notice of application to Parliament for the incorporation of a company to construct a tramway between the head of Lake Lindemann and the mouth of the Lewis River, to avoid the White Horse Rapids and other obstructions to navigation. Lafleur & Macdougall give notice for a company to operate a railway from Fort Selkirk to a point on the international boundary, on a route towards the mouth of the Stickeen River by way of the Hootalinqua River and Teslin Lake, with branch lines. A company applies for a charter through Geoffrion, Dorion & Allan, of Montreal, to build a railway from a point on the Lewis River, between Five Fingers and Fort Seikirk and a point on the international boundary, on a route towards the mouth of the Lynn Canal, with branch lines. Notice is also given of application for an act to incorporate a company to build a railway from the head of the Lynn Canal northward along Dalton's Trail to Fort Selkirk, N.W.T.

Marine News.

THE contract for masonry on the Soulanges Canal, recently taken rom A. Stewart, has been re-let to Ryan & Macdonald.

WOODEN ship-building is being carried on with renewed vigor in Newfoundland this season. Most of these schooners are for the Labrador trade.

THERE is a rumor of a new Canadian freight line between Halifax and Liverpool, but the parties whose names are mentioned, are reticent about giving information.

JOHN & MICHAEL O'LEARY have completed their contract on the Soulanges Canal, which covered section No. 3, the approximate value of the work being $230,000.

H. E. GIDLEY, Penetanguishene, Ont., is building a fine steam yacht for W. A. Gorby, Marion, Ind. She will be fitted with compound engines and a water tube boiler.

THE Albion Iron Works Co., Victoria, B.C., is fully employed building river steamers for the Yukon and Stickeen Rivers for the C.P.R., the Hudson's Bay Co., and others.

THE Donnelly Wrecking Company, which made arrangements to release the stranded steamer "Rosedale" for $17,000, has succeeded in placing the steamer in the dry dock at Kingston.

THE Klondyke Trading and Transportation Corporation, which Sir Charles Tupper organized, has purchased the first-class steamer "Amur" from Labaun. She will run to Stickeen and to St. Michael's.

J. H. MOIR, of New Westminster, B.C., has been awarded the contract for the construction of two stern-wheel steamers for the Stickeen River route by the Hudson's Bay Company. The steamers will cost about $20,000 each.

THE Hon. J. R. Thibaudeau, the Hon. A. A. Thibaudeau, C. N. Armstrong, E. A. D. Morgan, Montreal; R. Audette, Quebec; and L. H. De Friese, London, Eng., have applied for letters patent as the Atlas Steamship Company. The chief place of business will be Montreal, and its capital $500,000.

CAPT. C. H. MCLEOD, Pictou, N.S., is now at Portsmouth, New Hampshire, where a party of Klondykers is being fitted out. The captain has secured an engagement to take a vessel round Cape Horn, or through Magellan Straits, and the party expects to be at the mouth of the River Yukon when navigation opens.

THE London manager of the Canadian Pacific Railroad confirms the report that the company has bought from the Union Steamship Line the steamers "Tartar" and "Athenian," formerly the favorite liners in the South African mail service, and will establish a regular freight and passenger communication between Vancouver and Fort Wrangel, at the mouth of the Stickeen River. Each will do the trip within three days.

A CHARTER has been granted to L. L. Beer, C. Palmer, G. J. Rogers, J. Pitblado, W. W. Beer, T. W. Dodd, A. Kennedy, W. Welsh, R. Fraser, F. L. Haszard, Charlottetown, P.E.I., to acquire by purchase, lease or otherwise, and to build steamships and other vessels, docks, wharves and other terminal facilities, and to carry on the business of a transportation company for transport of passengers and freight, as the Inland Navigation Company, Limited, with a capital of $13,200.

FOLGER BROS., Kingston, Ont., have bought the steamer "Shrewsbury" and will put her on from Clayton to Montreal, along with the "America" during the coming season. The "Shrewsbury" was built at Bath, Maine, at a cost of over $80,000 about a couple of years ago, and has been in commission only a short part of the time since. Her dimensions are 161 feet 6 inches length of keel, 26 feet 6 inches beam, 7 feet 3 inches depth of hold and 47 feet 9 inches over guards. She has compound engines of the inclined type, 25 x 46 inches, six-feet stroke. There are two boilers, Worthington condenser, steam steering gear, improved feathering paddles.

AT a meeting of the board of directors of the Richelieu & Ontario Navigation Company, it was determined to call the new steamers to be built in Toronto the "Toronto" and the "Kingston." It was resolved to make repairs to the steamer "Laprairie." She will receive new feathering wheels. Other improvements to the western fleet are now in contemplation. The details in connection with the outfit of the company's steamers generally, the improvement of their appearance, and the interior of the saloons, especially on the "Quebec," and new conveniences for state-rooms, were also resolved on. Alterations to the steamer "Berthier" will also be gone on with, with a view of increasing her speed and carrying capacity.

THE C P R has completed arrangements in Toronto, for the construction of three light draught stern-wheel steamers to ply in Alaskan waters, in conjunction with the two ocean steamers which they have purchased in Scotland. These vessels will be constructed in Toronto, the contracts having been let to the Bertram Engine Works Co for two boats, and the Polson Co for one boat. The plans have all been prepared, and work will be commenced at once, as it is intended they shall be ready for the opening of navigation. The boats are of wood, plated with steel, and will have a length of 156 feet, with a beam of 30 feet. They will be put together in the Toronto yards and will then be taken apart and the parts shipped to Vancouver. The two ocean steamers' run will be from Vancouver to Wrangel, at which point passengers will be transferred to the new light-draught boats which will ply on the Stickeen River. Captain Troop, who is superintendent of a line of steamers plying in the Kootenay district, has been, it is understood, given the position of superintendent of the new line of C P R steamers in Alaska.

Personal.

W. W. Ogilvie has presented another $1,000 to the Winnipeg general hospital.

MANAGER SKIDMORE, of the Waterworks Company, Berlin Ont., will leave shortly for the United States.

A. MCDONALD, contractor, Woodstock, Ont., was killed by a G.T.R. train at a level crossing in Woodstock, Dec. 15th.

MORTON WEBB, mining engineer, son of F. R. Webb, Petrolea, Ont., returned from Colorado for the Christmas vacation.

JAMES LAMOND, formerly with E. Leonard & Sons, London Ont., has accepted a position with the Goldie McCulloch Co., Galt.

R. MAITLAND ROY, Peterboro, Ont., who has been connected with the engineering staff of the Central Bridge Co. for a number of years, has accepted a responsible position with the Hamilton Bridge Co., and will remove to the ambitious city.

WHILE visiting at the house of a friend in Toronto, Sylvester Neelon, well known as a member of the firm of Elliott & Neelon, contractors for the masonry work at the new municipal buildings, died suddenly of apoplexy. The body was taken to St. Catharines for burial. He was 74 years of age, had lived in St. Catharines for half a century, and was prominently engaged in extensive milling and timber business. He built the large Empire flour mills, which are now occupied by the Packard Electric Co., St. Catharines. He represented the county in the Ontario Legislature. He was president, up to the time of his death, of the Niagara Central Railway Company, and it was through his work that the road was built.

HURD PETERS, engineer in charge of the harbor improvements at St. John, N.B., was the recipient of a pleasant attention from the men employed on the works. The men employed about the works assembled in the warehouse and D. C. Clark, in their behalf, read an address to Mr. Peters, expressive of appreciation of his services, his constancy in attending his duty, his zealous care in the city's interests, and his pleasing manner, which had been an encouragement to them. Mention was made that the relations between Mr. Peters and the men had always been of the most pleasing character. The address was signed on behalf of the workmen by D. C. Clark, foreman of wharf construction; Thomas Thompson, foreman of warehouse construction; D. W. Clark, superintendent of pile driving; James McMurray, captain of dredge "Cape Breton"; John W. Dickinson, captain of dredge "Freeport"; James Fennell, captain of dredge "H. F. Bothfeld"; Frank S Henrion, diver. Accompanying it was a gold headed ebony cane, suitably inscribed, also a silver ice pitcher. Thomas Thompson made the presentation of the pitcher and D. W. Clark the cane. Mr. Peters said it was usual on occasions of this kind to say it is unexpected and surprising. All can bear me out, he said, that this is utterly and absolutely true in this instance. For forty odd years I have been connected with the city's work, and sometimes have done good work, and always have had pleasant and cordial relations with the men, but never till now have they given expression to it, and that I appreciate it you must know. My schoolboy holidays were spent in Carleton from the time I was ten years of age, and I have had a great deal to do with Carleton from the time I put in the waterworks, and have always found the workmen competent and efficient. A report I prepared some time ago for presentation to the harbor improvements committee gives expression to my opinion of the excellent way in which you have worked. It gives all due credit to the foremen, but shows that the completion of the work is due to the men, who throughout have shown a friendly spirit and have worked with vigor and energy. Never was more work done, and better done, in five months; and every man who

used an axe or an adze has earnestly done his share in bringing it to a successful conclusion. Mr. Peters concluded by again thanking the men and assuring them of his good wishes, and declaring if the city undertook, as he hoped it would, the completion of the work on the other side of the slip, that they were the men for it.

—Every manufacturer of first quality paving brick is directly interested in establishing a uniform method of testing paving brick, as a matter of self preservation, for uniform tests mean impartial comparison. Hence, it behooves paving brick manufacturers, or municipal officers and city engineers to have a copy of the Report of the Paving, Brick Commission. It is a neat book of 110 pages, containing all of the comparative tables and charts compiled for the National Brick Manufacturers' Association of the U. S. by a special Commission, under the direction of Prof Edward Orton, Jr. The universal adoption of the methods recommended by the Commission will redound to the credit of paving brick and to the profit of the manufacturers. Copies may be had through THE CANADIAN ENGINEER at $1.00 per copy.

—We have received the fifty-first volume of the Canadian Almanac from the publishers, Copp, Clark Co. Limited, Toronto. Besides being a directory of clergy, militia, Government officials, members of Parliament, county and municipal officers, schools and colleges, barristers and solicitors, and other public men, it is a compendium of information of all kinds relating to Canada. Some of the more prominent departments are; Short History of Canada, Tariff of Customs Forms of Government throughout the world, Post Office Gazeteer Masonic Lodges, Miscellaneous Societies, Historical Diary, Life Insurance. Some new features for 1898 are: Short accounts of the British Army and the British Navy, with illustrations; also articles on the English Government, and Extraditions and Pardons. Besides the above, with every copy of the Canadian Almanac for 1898 is presented a map of North America, beautifully engraved and printed in five colors. The price, 25 cents.

—The annual meeting of the Atlantic and Lake Superior Railway was held in Montreal, on the 3rd inst. The President in his report said the arrangement made by Mr. Armstrong with the London syndicate was, for the present, a confidential document; but under the agreement, the company had constructed 20 miles of road between Caplin and New Carlisle, and trains are running on that section. Two parties of engineers are about to start locating the line between Paspebiac and Gaspe. The line as far as Port Daniel, 25 miles long, is an easy section, but between that point and Gaspe, several surveys will have to be made before the best route can be selected. The company has also done considerable work between Yamaska and Levis on the Great Eastern Division, grading being nearly finished between the St. Francis and Nicolet Rivers. Traffic will be open between Nicolet and St. Gregoire, and to St. Angele, opposite Three Rivers, this month. The directors have bought from the C.P.R. the section of the South Eastern between Sorel and Yamaska, including the Yamaska river bridge. This makes a connection with the South Shore Road, and the C.P.R. and United Counties Railway will pay for running rights over it. The section between Yamaska and Levis will probably be finished before the close of 1898, and wharves, warehouses, etc., will be constructed at Paspebiac, and the Government will be asked to assist in building this port. The section between Riviere du Loup and Metapedia will be 115 miles, or 60 miles shorter than the Intercolonial between the same points. This country is as yet unsettled, but is well timbered and watered, and the soil is rich. The following officers were elected: President, Hon. J. R. Thibaudeau; first vice-president, Hon. Wm. Owens; second vice-president, Hon. V. W. Larue; secretary, E. N. Armstrong; general manager, C. N. Armstrong. The three representatives of the Quebec Government, Hon. V. W. Larue, Jas. Baker, and Chas. Chaput, were continued in office.

Industrial Notes.

F. J. HENDERSON is building a butter factory at Gananoque, Ont.

THE town of Goderich is applying to the Ontario Legislature for authority to spend $50,000 in building a grain elevator.

THE E. B. Eddy Co., Hull, Que., has, it is said, entered the Diamond Match combination, and will greatly enlarge its premises as a consequence.

THE city of Hull, Que., has ordered 500 tons of pipe from the St. Lawrence Foundry Co., Toronto. The pipe will be in sizes running from 3 to 15 inches.

THE Victoria, B.C., Metallurgical Works Co., Limited, has been incorporated.

H. C. MCBRIDE, architect, London, Ont., won the competition by his plan of the Jubilee Hospital for that town.

THE Auburn Woolen Mills, Peterborough, are putting in an improved system of fire protection, and have ordered a number of hydrants, check and gate valves, from the St. Lawrence Foundry Co., Toronto.

THE Hamilton and Toronto Sewer Pipe Co. is now building an up-to-date factory, which will enable them to maintain in future the excellence of their product in the past; in the meantime, stocks on hand are sufficient for the trade till the factory is completed.

ACETYLENE gas is said to be making headway in many parts of Manitoba, particularly at Morden, where the apparatus is manufactured. The underwriters' regulations for the use of acetylene are, our readers will remember, much less severe in Manitoba than in Ontario.

THE E. B. Eddy Company, Hull, Que., is adding eight new 5x14 feet tubular boilers to the battery of 24 boilers. The new boilers are to be used as auxiliary to the present water and steam power plant, and will drive some of the small paper and printing machines, and the pumps and engines.

THE Verity Plow Company has decided to remain in Brantford. The company wants $15,000 for the old buildings, exemption from taxes and free water, an 8-inch main being necessary for the new works. The building they will erect is to cost not less than $40,000. The company will give $10,000 guarantee that they will remain in Brantford for five years, and a $5,000 guarantee for five years longer.

THE property of the Guelph Norway Iron and Steel Company was sold a short time ago for $9,700 to John Taylor, formerly employed by the company. Forty-eight thousand dollars was invested in the enterprise. Work on the building was commenced in May, 1895, operations began in January, 1896, and the mill ran off and on until May, 1897, when it was closed. The stockholders will lose everything, it is said, and the creditors get about eighty-five cents on the dollar.

A FLOOD was caused at Norwood, Ont., Dec. 15th, when the dam of the pond used to run Jas. Cummings' woolen mills gave way, and coming in contact with Nield's foundry, owned by J. L. Squier, it completely demolished it. Part of the stream entered the woolen mills and did considerable damage. The water carried away three bridges, and hundreds of cords of wood owned by J. Finlay & Son, Squier Bros., and James Cummings.

F. E. DUCKHAM, engineer of the Millwall Docks, London, England, was in Kingston, Ont., recently, with the view of getting the Canadian Engine and Locomotive Works for the building of two Duckham pneumatic grain elevators for the Montreal Pneumatic Grain Elevator Company. The pneumatic elevator, in addition to pumping grain, can transmit it horizontally 700 or 800 feet along a pipe to the warehouse and elevate it to a height of 80 feet to various bins. In loading vessels it can, it is said, handle grain at the rate of 180 tons per hour, screening, grading and weighing it in the transmission.

THE organization meeting of the Jacques Cartier Pulp Co. was held December 11th, 1897, when E. Golf Penny, Wm. Law, and W. Currie were elected trustees and Geo. McDonald, secretary, to carry on the business till incorporation is secured. This company will buy the pulp mill at St. Jeanne de Neuville, which has been sold to them by E. Bradley, C.E., for the owner, James Reid, of Quebec. The company proposes to put in new machinery to double the output. American and German experts have viewed this water-power and pronounce it unique, as nature has done most of the engineering work by a natural tunnel underground, about 600 feet long, producing a fall of 65 feet. The future capacity of the mill will be ten tons per day, mechanical.

THE terms of the agreement entered into between Abbott & Co., Montreal, and the city of Kingston, Ont., relative to the removal of the works to that city, have been made public. The company will be given a free site and a bonus of $50,000; the plant and machinery to be valued at $250,000 by a board of valuators, who will make their award ten days after the works are in running order. Abbott & Co. agree to carry on the business twenty-five years, and employ during the first year 125 to 150 hands. The pay-roll is to range from $40,000 to $50,000. Before the end of the second year the company will employ from 175 to 200 men, their pay-roll to range from $50,000 to $60,000. The city will have the first lien on the buildings and plant to the extent of the bonus for the period of twenty years, and the works must be operated 275 days in each year.

PARRSBORO', N.S., will spend $4,000 on firehall equipment.

A PEQUEGNAT'S bicycle factory, Berlin, Ont., is being equipped.

JAS. CAMERON, Fallbrook, Ont., is starting a sawmill at Harper.

A NEW market building is proposed for Brantford, Ont., to cost $4,000.

THE city of Ottawa purposes to spend $70,000 on buildings in Lansdowne Park.

E. R. SIMPSON & Co., engineers and machinists have begun business in Berlin, Ont.

WINNIPEG will spend $700,000 on a system of water works, to be supplied from artesian wells.

THE Welland Vale Bicycle Co., St. Catharines, Ont., is manufacturing a chainless bicycle for next season.

THE Rathbun Company, Deseronto, Ont., has been shipping carloads of doors, etc., to South Africa, recently.

W. P. NILES may build a roller flour mill at Wellington, Ont., the village having granted exemption from taxes.

A. E. CARPENTER has sold out his interests in the Hamilton and Toronto Sewer Pipe Company to Henry New.

E. L. PERKINS and W. H. Heine are interested in organizing a wood-working company, at Norton Station, N.B.

THE Canada Screw Co., Hamilton, Ont., is applying for an extension of the exemptions enjoyed for some years past.

H. & F. GIDDINGS & Co., Granby, Que., will build a new furniture factory, 50 by 100 feet, and five stories high, in the spring.

THE Exploits Lumber Co. is to be incorporated to do a large lumber business in Newfoundland. The capital is English.

IT is said that a combine including every wire rod, nail, and other wire product in the United States will be in operation before Feb. 1st.

GEORGE MCARTHUR, St. John, N.B., has been awarded the contract for building Doran's Hotel, Windsor. The contract price is over $20,000.

THE work of enlarging and improving the Rathbun Company's cement works, at Napanee Mills, Ont., is being pushed by a large staff of men.

THE town of Wardner, B.C., which has grown up where the Crow's Nest Pass Railway is to cross the Kootenay River, is experiencing quite a boom.

THE Dominion Elevator Company is now erecting elevators at the following points: South Edmonton, 20,000 bushels; Laduc, Wetaskiwin, and Red Deer, 15,000 each.

THE town of Welland, Ont., is to be piped at once for a natural gas supply. The rates charged will be the same as in Dunnville, Ont., *i.e.*, $35 a year for furnace; $24 for a cook stove; $19.35 for a heater.

AN order has been received at the C.P.R. car shops, at Perth, Ont., to build 20 first-class passenger cars and 10 sleepers. Hitherto only freight and box cars have been manufactured at the Perth shops.

INCORPORATION has been granted to M. M. Boyd, W. T. C. Boyd, Bobcaygeon, Ont.; G. Boyd, J. Wickham, Toronto; J. D. Flavelle, and J. G. Edwards, Lindsay, as the Cowichan Lumber Co., Limited. Capital, $150,000.

THE case of Dale *v.* the Riordon Paper Mills, Limited, Merritton, Ont., has been settled for $1,500 out of court. James Dale, who was severely scalded at the mill some months ago, brought an action for $2,500 against the company.

J. T. CHILD, C.E., of Child & Wilson, Calgary, N.W.T., was at Lethbridge recently making an estimate of the probable cost of a system of waterworks for that town. Medicine Hat is also looking for a waterworks system, it is said.

C. GUIMOND, Beauharnois; C. F. Lalonde, Montreal; J. Leduc, J. B. Roy, Delia Rochette, Beauharnois, Que, are applying for a Dominion Charter as the Star Iron Company, Limited, to manufacture furnaces, etc. Chief place of business, Montreal; capital, $60,000.

THOS. DOHERTY, Sarnia, Ont., the inventor of the famous iron casting process, is now engaged upon the invention of a further improvement in this process of iron production, of which great things are predicted by those who have been given an inkling of the new idea.

THE creditors of Robert Saxby, engineers' supplies, Toronto, met recently, when a statement was presented showing liabilities of $3,200, with assets of about $4,000. The chief claims are: John Herrington estate $1 700, secured by a $1,000 mortgage and $300 note, endorsed; E. E. Cooch $550, Bank of Commerce $100, Royal Oil Company $125, and Robert Saxbury, jr., $300. The assets consist of land $3,500 and the remainder stock and book debts.

THE company which is working the peat beds near Welland, Ont., is going into the manufacture of artificial marble from gypsum.

THE city engineer, Montreal, has asked an appropriation of over $1,000,000, chiefly to be spent on new sewers and enlarging old ones.

THE town of Magog, Que., has recently installed a municipal electric lighting plant, and now proposes to add a system of water supply, the same power plant being used as for the lighting system, and the pumping being all done during the day when there is no demand for electricity.

J. M. LAVOIE, E. Lavoie, O. Matton, Ottawa; A Lavoie, Donald, B.C.: J. M. McDougall, Hull, Que, have been incorporated under the Dominion statute as the Lake Deschenes Milling Company, Limited, with a total capital stock of $40,000, to build flour and other mills, and do a general milling business.

THE average nightly attendance at the Toronto Technical School was 230 during October and November. The building is to be enlarged for the use of the school by the University of Toronto, which owns it, at an expense of $26,000. The Technical School will pay a rental of $2,000 per year for 21 years.

PLANS have been brought forward for extending the Bonsecours market, Montreal. The plan would extend the market to Jacques Cartier square, and then take in property and land on St. Paul, Bonsecours and Leroyer streets, extending the latter street through to Bonsecours street; a large square would thus be added to the market.

THE Ontario Sewer Pipe Company, Mimico, Ont, has completed what is said to be the largest sewer pipe kiln in the world. It measures 36 feet 7 inches in diameter, seven inches larger than the one built by the Great Western Sewer Pipe Company, Ohio, and about 19 inches larger than those of the Black Horse Sewer Pipe Company, Virginia

THE Acton Tanning Co. and Beardmore & Co., Acton, Ont., are putting up new buildings. The carpenters are busy on two new hair houses, one for each establishment, 32 x 50. J. A Speight & Co. are finishing two large cedar water tanks for the Acton Tanning Co., fifty-seven feet in circumference and twelve feet deep.—*Acton Free Press*, Nov. 25.

A NEW company has been formed to operate the Coldbrook Rolling Mills, near St. John, N.B. The new company, which is styled the Coldbrook Steel and Iron Company, has appointed W. H. Thorne & Co., wholesale hardware merchants of St. John, as their selling agents, The company will manufacture bar iron, railway spikes, and wrought spikes.

A PRACTICAL demonstration of a new process of jointing pipes took place recently at the Caledonia Iron Works, Montreal, in the presence of some influential pipe-makers, contractors and others. The process of making and fixing the ring joint is an entirely new departure from the customary methods employed in jointing pipes, and overcomes the difficulties incidental to pouring and caulking lead into pipe joints in wet trenches. A full description of this process appears in THE CANADIAN ENGINEER. The inventor is D. J. Russell Duncan, C.E., 28 Victoria street, London, S.W. The ring joint is made with cold sheet lead, which is circumferentially contracted and indented by the pressure of a contractible tapering wedge and an external compression ring.

IN connection with the mention made in past issues of THE CANADIAN ENGINEER of the different appearances of strange aerial bodies, by many believed to be air-ships, the following press despatch, dated from Pittsburg, Pa., may be of interest: "It has at last been discovered who the incorporators of the Atlantic and Pacific Aerial Navigation Company are. The company, which is officered by C. A. Smith, president, and M. A. Terry, secretary, both of San Francisco, was organized to manufacture the air-ship of Hiram S. Maxim, inventor of the Maxim gun. It is said by persons connected with the company that last summer a trip was made in a Maxim air-ship from San Francisco to Cleveland and back in three days. Mr. Maxim furnishes the following description of his vessel: It occupies 106,000 cubic feet of space. The propelling power is a 105 horse-power naphtha engine. The cylinder engine and all other parts of the machine, so far as practicable, are made of aluminum, which was purchased of the Reduction Company here. The ship now weighs about 5,000 pounds, and will, its friends claim, carry more than a ton weight of provisions and passengers. The naphtha for the engine will be stored in cases, which are supposed to hold enough to drive the ship around the earth without replenishing the tanks. The tail that projects upwards from the stern of the ship is intended to direct it up or down as a bird directs its movements with its tail. The rudder is to change the course from right to left. Motive power is secured by the big aeroplane at the stern, which is driven by the naphtha engine. It is stated that a speed of one hundred miles an hour has been attained without straining the machinery."

MONAGHAN & SUTHERLAND, contractors, Halifax, N.S., assigned not long ago to T. Frank Courtney.

THE Strathroy Furniture Co. is building a sawmill in connection with its factory, capacity, 15,000 feet per day.

RICHARD SCHOFIELD, Toronto, recently put in an electric mail-marking machine in the Hamilton Post Office.

POWER & SON, architects, Kingston, Ont., are preparing plans for a new elevator for Richardson Bros., Kingston.

AN acetylene gas company is to be established in Carleton Place, Ont., and has already asked for street privileges.

THE Goldie & McCulloch Co., Galt, Ont., recently shipped a large boiler to the Ontario Rolling Mills Co., Hamilton.

THE Methodists of Brandon, Man., will build a $30,000 church next season. S A. Bedford is chairman of the building committee.

HARLAND BROS., Clinton, Ont., hardware, are putting in a 40-light acetylene machine and will furnish some neighboring firms with light.

THE Waterloo, Que., waterworks, owned by Gould & Wilson, will shortly pass into the possession of the municipality, which gives in the neighborhood of $21,000 for them.

Two carloads of screens from the Jenckes Machine Co., Sherbrooke, were received at the mills of the Chicoutimi Pulp Co. recently, and are now being set in place.

THE Montreal City Bill, now before the Quebec Legislature, proposes to give the city the right to borrow $250,000 for the extension and improvement of Bonsecours market.

THE Canadian Typograph Co , manufacturers of the well-known E. & D. bicycles, have received orders for 150 of their wheels from South Africa, nearly 100 of which have already been shipped.

FOUR municipal by-laws were voted on in Galt, Ont., Jan. 3rd, all of which were defeated, viz. : $7,000 for market extension; $8,000 for new fire hall ; $3,000 for hospital sewer ; $1,800 for electric fire alarm.

THE Windsor, N S., Plaster Co. commenced grinding plaster early in December, and is now able to supply the celebrated Selenic Cement. This is the first manufactory in Windsor to begin work after the fire.

THE plant of the Phelps Machine Co., Eastman, Que , has been bought out by the Jenckes Machine Co., of Sherbrooke, which will continue the manufacture of the Dake engine in the Sherbrooke works.

THE City of Belleville, Ont., owns its gas works. The original investment was $14.400. The dividends in twenty years have amounted to $28 224 in addition to two per cent. which has been put aside each year for repairs and improvements.

R. MACKIE has been appointed engineer of the new sewage disposal works, Hamilton, Ont., at a salary of $600. Mr. Mackie holds a first-class certificate, and has been engineer at the Hamilton Bridge Co., the Copp Bros., Limited, and the Rolling Mills.

AT the annual shareholders' meeting of the Dominion Wire Manufacturing Co., Montreal, the following directors were elected by the shareholders : James Cooper, president ; C. W. Vollmann, vice-president; J. C. McCormick, managing director ; F. W. Fairman, H. Horsfall.

AT the annual meeting of the Montreal Metal and Hardware Association the following officers were elected : President, George E. Drummond; vice-president, J. B. Learmont ; treasurer, J. W. Pyke ; directors, Charles Cassills, Frank Caverhill, Robt. Gardner, and C. L. Letang. A resolution was passed endorsing the limitation of credit to four months and 3 per cent. for cash.

WATER was let into the penstock at the pulp mills at Chicoutimi on the 15th ult. The mill, it is expected, will be in full operation by the 20th. The development of the water power in connection with the mill was undertaken by the Jenckes Machine Co., of Sherbrooke, Que., which used four special Crocker wheels for the purpose. The wheels give excellent satisfaction under the usual head of 70 feet.

DR. C. J. EDGAR, North Hatley, Que., has formed a partnership with W. O. Roy, of Montreal, and acquired a water power on the Massawippi River, a little below the village. They will furnish electric lights and power to North Hatley, Eustis and Waterville. A contract has been made with the Jenckes Machine Co., Sherbrooke, Que., for developing the power, and the whole plant will be put in at once.

J. P. CARRITTE, St. John, N.B., and J. W. Patterson, of the Patterson Manufacturing Company, Montreal, have contracted with the People's Heat and Light Company, Halifax, N.S., for the company's tar output, and will have erected as soon as possible a factory on the North-West Arm, for the manufacture of tarred roofing and building paper, and all bi-products of tar. They have bought plant in New York, and plans have been prepared for the buildings. The works will be ready for operation in the latter part of February, it is expected.

YARMOUTH, N.S., will build a $15,000 school.

THE reservoir of the Parrsboro, N.S., waterworks has been completed.

E. D. SMITH, Winona, Ont., fruit grower, is spending $5,000 on a cold storage warehouse.

THE Detroit Lubricator Co. has recently received orders for 100 locomotive lubricators, which are to be shipped to China and Japan.

MADISON WILLIAMS, who is now proprietor of the foundry and machine shop of the Paxton, Tate & Co. estate, Port Perry, Ont., is doing a good business.

THE new pulp mills of the Royal Paper Mills Co. at East Angus, Que., are rapidly nearing completion. The contract for the entire tank work has been awarded to the Jenckes Machine Co., Sherbrooke, Que.

THE Rev. D. B. Marsh, Black Heath, Ont., inventor of the Marsh stethophone, is now taking out patents in the United States and several European countries. Mr. Marsh has made a number of improvements on the instrument since the patent first issued in Canada

THE trouble between the Customs Department and the Canadian agents of the La France Engine Company has been settled by the payment of $441 additional duty and fine. The company, in a letter, gave the lowest price of the engine as $4,200. When it reached Canada it was entered at $3,570, that is 15 per cent. less than $4,200, This $630 was understood to have been the Canadian agents' commission at 15 per cent. The Customs authorities have now decided that the correct value for duty was $4 300, and has collected 35 per cent. on this $630 deducted, with a fine of 100 per cent. on the amount of undervaluation.

SINCE the publication of the article on towns' water supply in our June number, which points out the poisonous effects of lead pipe on drinking water, we have received from E. Walker & Co., water pipe manufacturers, Heckmondwike, Yorkshire, England, a sample of their wrought iron pipe lined to a thickness of over one-sixteenth of an inch with block tin, and a suitable connecting coupling lined so that the water cannot possibly come in contact with the iron, even at the joinings. They also make iron pipe with a non-conducting material or insulator placed between the iron pipe and the block tin lining, which they claim prevents frost penetrating the pipe and freezing the water. This overcomes the difficulty pointed out, and supplies a pipe almost everlasting in wear, and that cannot rust, or in any way destroy the purity of the water. The sample can be seen at the office of THE CANADIAN ENGINEER.

J O. LA FOREST, superintendent of the Montreal waterworks, has again called the attention of the city council to the danger that will attend further neglect of the long-needed waterworks extensions. The high level reservoir contains about 1,750,000 gallons, or less than 24 hours' supply for the district it serves ; while the only engine capable of duty at the McTavish street station is worked beyond its capacity, so that there is no time for overhauling in case of accident. The water supplied from the high level reservoir has increased enormously in recent years. In 1885 it was 48 986,086 gallons, while in 1896 it had risen to 662,572,822 gallons. A new engine is urgently needed at a cost of about $40,000, including erection, and an additional boiler at a cost of $19,650, including alterations to the buildings. The cost of connecting the two sections of the reservoirs to the suction pipe, and the continuation of the 20-inch main to the high level reservoir, will add about $10 000 more to the cost of the needed improvements.

To the first person sending us The Canadian Engineer of December, 1893, or March, 1894, we will pay 50 cents or one year's subscription, or we will pay $2 cash or three years' subscription to any one who will send us Volume I complete.—Biggar, Samuel & Co., 62 Church St., Toronto.

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. V.

ROADBED CONSTRUCTION.

ARTICLE 23.—MASONRY BRIDGE PIERS.

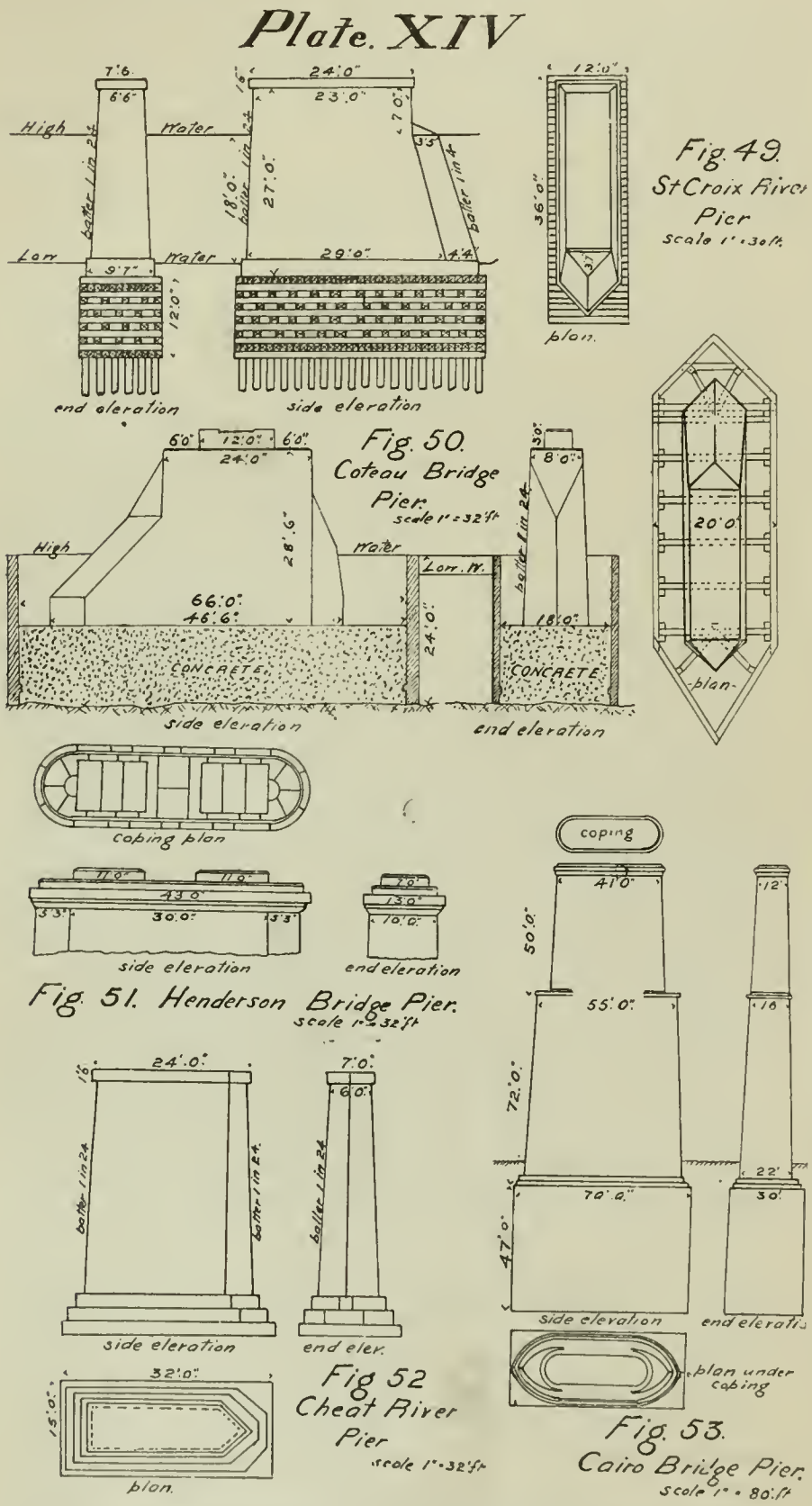
The material most commonly used for masonry pier construction is stone, although in certain cases brick may be cheaper and also satisfactory; but wherever there are strong currents of water or jams of ice or logs, brick is hardly suitable, as the individual pieces are liable to displacement; but concrete piers are becoming quite common in certain parts of America, the compact and simple form of a pier lends itself readily to concrete construction, the ebb and flow of tides will not affect well made concrete whereas it has a disastrous effect often even on the heaviest class of masonry, percolating through the many joints loosening the stones and mortar; concrete piers are usually much cheaper than first-class masonry work, and even the compromise of a pier with the sides and top of stone and the interior of concrete, offers considerable saving. In designing piers located in river beds we have three special questions to study, namely, the dimensions and construction of the coping, the batter of the sides to insure stability, and the design of the cutwaters; of course the question of foundations enters into designing this class of work even more seriously than with structures built on land, but the subject of foundations will be taken up in a more general way applicable to all structures.

(1) The coping dimensions will be determined by the width apart of the trusses, the size of the bed-plates, and the loads to be carried locally on the masonry work, the variation would be for single track roads, from say 4 feet by 16 feet under coping for small deck trusses to as large as 12 feet by 40 feet for long through spans. The coping should project two or three feet beyond the bed-plates at the ends, and six inches to two feet at the sides, depending on the weight of the span. Copings should consist of an 18-inch thickness of very strong carefully made concrete, surfaced with a layer of 1 to 1 mortar before the concrete has set, or if of stones, they should be large, well-bedded, cut all over the top surfaces by fine pointing, pean hammering, or in some way giving a good surface for the bed-plates; the vertical joints should be cut and preferably the beds also; but the faces look better with the quarry face left on, if the rest of the pier is rock faced ashlar. They should be dowelled into place, or clamped to one another, and so arranged that the pedestal plates of the bridge trusses will come *exactly* on the centre of a large stone, or if one stone cannot be found large enough to distribute the load, a large, deep pedestal block should be cut for the purpose and placed on top of the coping; for very large trusses, a steel pedestal is constructed to distribute the load over several coping stones (*e.g.*, new Victoria Bridge). Coping plans showing the exact size and position of each stone should be furnished the contractors, and it is a mooted question, whether better results as to exact surface, etc., can be obtained by bedding in mortar, or by shimming up the whole coping to an exact level on wooden chips, then pointing up all the outer bed and vertical joints, and pouring liquid grout into the receptacle of interior joints and beds thus formed until every crevice is filled, the latter plan is probably preferable, if care is taken to have the joints and beds open enough to secure their being thoroughly filled, particularly the beds.

(2) The batter of the sides is usually 1 in 12 or 1 in 24 and is a matter of appearance, as vertical piers would look top heavy, but in each case a calculation should be made for stability, under the most unfavorable circumstances; considering the stability in direction of the railway line, the forces acting would be (*a*) the wind blowing at 45° to the direction of truss, on the truss, train and pier, at say 40 lbs. per square foot, the force of a fully braked train covering one or two spans depending on the location of the expansion rollers, at say, 10 per cent. of the weight of the train, and vertical loads which would consist of a *loaded* span and the weight of the pier itself; the resultant of these forces should not fall appreciably outside the middle third of the base, (*b*) with the wind as before, but

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

blowing on the truss and pier only, and the vertical loads of an *unloaded* span and the weight of the pier itself, the same criterion for stability should be applied as in (*a*), and in either case the remedy for instability would be to increase the batter, or introduce steps or offsets of, say, 6 inches every 10 or 12 feet, which would have the same effect. The stability of a pier at right angles to the bridge is practically never in question unless of very great height, in which case similar tests would determine what the necessary length of base should be.



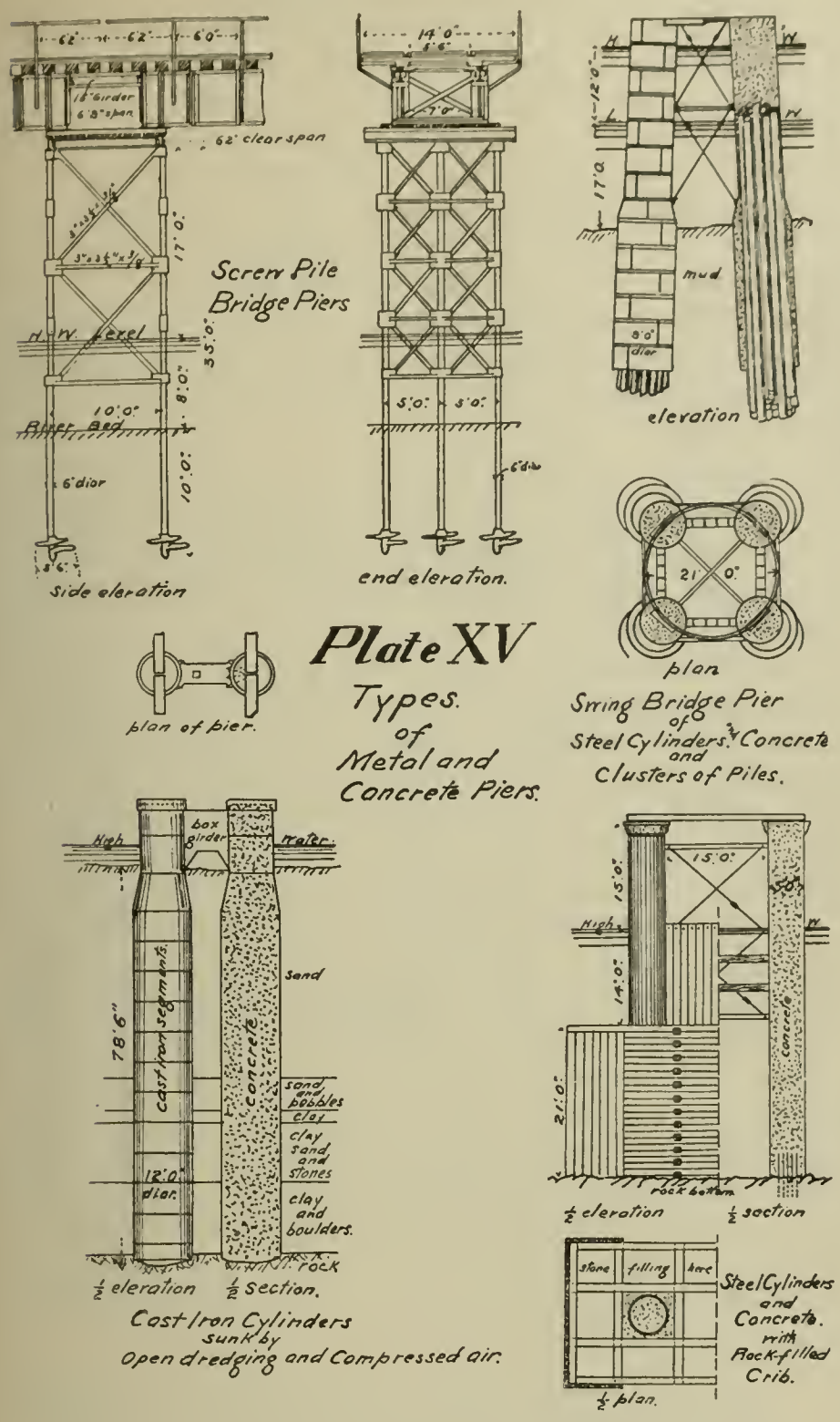
(3) Cutwater designs:—Wherever there is any appreciable current in a river, it is necessary to construct the up-stream end of the pier of such a form that it will divide masses of driftwood, ice, logs, etc., as well as the current itself. Probably the simplest form is that shown in Fig. 52, which will not cost appreciably more to construct than a square pier, as the nose is a right angle and the faces of ordinary quarry-faced ashlar, but such a form is suitable only for streams carrying light ice or moderate jams of logs; in place of this the more ornamental forms shown in Figs. 51 and 53 would be equally satisfactory, especially the latter, but cost considerably more, and should therefore be used only on very important structures.

Where piers are to be placed in swift currents, or in any stream carrying heavy jams of logs, or thick floes of ice, their cutwaters should be of designs similar to Figs. 49 or 50. The cutwater of the former hardly extends high enough and is not flat enough for Canadian rivers, and besides it lacks the valuable addition of a small pointed lower end, which is introduced to eliminate an eddy at that point in swift currents, which tends to undermine the end of the pier, unless on solid rock. Probably the St. Croix pier and cutwater are suitable for the conditions they were designed for, but the intention of the design on Fig. 50 is that the jams will rise on the nose and split in two, passing on harmlessly.

Stone masonry bridge piers will cost from $9 to $15 per cubic yard, depending on their height, size and the cost of quarrying, transporting and cutting suitable stone. If expensive cutwaters are needed this will add to the cost; those used under severe conditions being of a first-class cut stone construction of large dimensions, clamped together and dowelled also, with a strip of boiler plate added to the nose to prevent dislodgement of stones. The following specification of first-class bridge masonry will apply to both abutment and pier construction, but in many cases a less severe specification has resulted in satisfactory and durable work.

Specification for First-Class Bridge Masonry.—"This class of masonry will be ranged rockwork of the best description, from stone of approved weathering qualities, and will be laid in suitable cement mortar (1 to 2 natural, or 1 to 3 Portland). The face stones will be accurately squared, jointed and bedded, and laid in courses not less than 12 inches thick, decreasing in thickness from bottom to top of walls; the joints and beds to be less than half-inch and joints well broken, no break to be less than nine inches. The stretchers to average at least $3\frac{1}{2}$ feet in length with 3 feet as a minimum, to have at least 16 inches bed, and always at least as much bed as rise. The headers to have a width of not less than 18 inches, and to hold the size back into the heart of the wall that they show on the face; they shall occupy at least one-fifth of the area of the face of the wall, and be practically evenly distributed over it, so that the headers in each course shall divide equally or nearly so, the spaces between the headers in the next course below. When the walls are not more than $3\frac{1}{2}$ feet thick, the headers shall run entirely through, and when between $3\frac{1}{2}$ and 6 feet thick, there shall be as many headers of the same size in the rear as the front of the wall, and the front and rear headers must alternate and interlock at least 12 inches with each other. In walls over 6 feet thick, the headers shall be at least $3\frac{1}{2}$ feet long, alternating front and back as just described, their binding effect being carried through the wall by intermediate headers of a similar character. The stretchers in the rear of the wall, and the stones in the heart of the wall shall be of the same general dimensions and proportions as the face stones with equally good bed and bond, but with less attention to vertical joints, and must be well fitted to their places, and carry the course evenly quite through the wall; a header shall in no case have a joint directly above or below it, but rest entirely on a stretcher at the face; any small interstices that may remain in the heart of the wall shall be carefully filled with mortar and spauls. The face stones shall be left rough on the face, with no projection of more than three inches from pitch lines, and two-inch drafts will, in general, be carried up and around all projecting angles. In the construction of piers, it is understood that the description above given for face work shall apply to both ends and both sides of the pier. Copings are to be cut and dowelled or clamped according to coping plans furnished, the top shall be crandalled and pean-hammered,

or otherwise brought to a smooth surface, and so arranged as to bring the pedestal plates of the trusses exactly on the centre of especially large coping stones of dimensions given on the plans."



ARTICLE 24.—METAL OR METAL AND CONCRETE PIERS.

On Plate XV. are shown several applications of metal and concrete for bridge piers. The method by screw piles founded in mud is quite unique and has not been attempted in America for railway bridge piers, but the steel cylinders filled with concrete and founded either in mud on piles or anchored to the rock by iron dowels are more familiar. For light highway bridges this method is quite suitable, but it is probable that, except in the form of one large cylinder, as a cofferdam to a pneumatic caisson, both filled with concrete and sunk in waters not needing cutwaters, their use for railway bridge piers will be exceptional, as the more massive forms shown on Plate XIV. will be better able to withstand the vibrations of trains and impacts of ice, etc.

ARTICLE 25.—IRON VIADUCTS OR TRESTLES.

The features usually under the control of the railway engineer are the general lay-out, the design and construction of masonry, and the erection of iron work; the detail designing of the iron being essentially a branch of bridge-work.

(*a*) *General lay-out.*—This has resolved itself in America to be, in general, a system of braced independent towers and suspended spans (see Fig. 54); the towers are usually about 30 feet spans, with posts vertical in side elevation; and, in end elevation, the girders are spaced 8 to 10 feet centres, and the posts battered at 2 to 3 inches per foot, depending on the allowance for wind, the aim being to avoid tension in the windward pedestals at the most unfavorable instant. The suspended spans are usually also plate girders of 30 feet to 60 feet span, depending on the height, the greatest economy being claimed when the cost of girders and longitudinal bracing is equal to the cost of towers and pedestal masonry. The usual design is with diagonal rods acting in tension and the girders resting on top of the posts, with slotted holes for expansion, but some late designs are for rigid, riveted bracing and posts extending to the tops of the girders, which are riveted to the webs of the posts, temperature changes being taken up in expansion pockets every 100 to 200 feet. This system is theoretically more rigid, but costs more and demands a perfect system of pedestals, any settlement being dangerous to a proper distribution of stress.

In estimating the weight of iron for approximate work, the following rule may be useful:

The weight of metal in the towers and bracings, in pounds, is equal to about $8\frac{1}{2}$ times the longitudinal section area in square feet of the ravine below the line of girders and between the faces of abutments; this is based on a 100-ton consolidation engine and a high viaduct, say 100 feet, this will be changed to say $9\frac{1}{2}$ times for a viaduct 50 feet high, and $10\frac{1}{2}$ for a viaduct 35 feet high with the same weight of engine. The weight of girders, in pounds, may be estimated at $(9l+100)$ pounds per foot run of a span, where l = length of span. The price of iron varies considerably, with cost of erecting falsework, if any, and cost of erection and freight in general, but is about four cents per pound, in place, as a minimum. The floors of viaducts usually consist of say 8-inch by 10-inch oak ties about 12 feet long on their edge, boxed one-inch over the girders, and fastened to them by hooked bolts which pass through the guard rails and hook under the upper girder flanges; the spacing should be not more than six inches clear, and guard rails either double or with an inner guard rail of ordinary flanged rail. Some recent designs, however, call for solid floors of steel troughs filled with ballast and with ordinary track ties, which, certainly, would lessen vibration and increase safety in case of slight derailments.

(*b*) *Pedestal Masonry.*—The greatest care must be exercised in laying out and building the abutments and pedestals, as any error in position or appreciable one in height is very serious, because the iron work, being manufactured at a distance contemporaneously with the masonry, is shipped to the spot partially assembled, and cannot be afterwards altered except by a slight shimming up of pedestals built too low. The shoes of the columns are always bolted down to the copings, and in high structures these bolts should be built into the pedestals 5 or 6 feet, by passing through the stones as they are laid in place (see Fig. 54), the bolt holes are afterwards filled tight with sulphur, lead, or neat cement grout, while if the structure is not very high or subject to heavy winds, the anchor bolts are only sunk into the coping stones, dovetailed by wedges and cemented as before. Pedestal masonry is sometimes built of well burnt brick covered by a stone coping, and the use of monolithic concrete is especially adapted to this class of work, as it permits of the anchor bolts being buried in the concrete to any depth during construction. In any case the best class of work must be done, as the strains and thrusts acting are of higher intensity than in ordinary masonry, and the pedestal is not only under considerable vibration for so small a

mass, but may be put in tension on the windward side of high structures. The cost of stone pedestal masonry will vary with the conveniences for handling small quantities of large stones at each spot, and with the amount of cutting required, from $10 to $15 per cubic yard, whereas a very high class of concrete may be done for at the most $8 per yard as there is nothing to move from place to place but the plank molds and mortar box. The coping of concrete pedestals should be made very strong, say, 1 cement, 1½ sand, 3 stone, with a layer of 1 to 1 mortar for 1½ or 2 inches thick on the top and sides, put on at the same time as the rest is being built, and incorporated with it by vigorous trowelling and ramming, etc.

Plate XVI

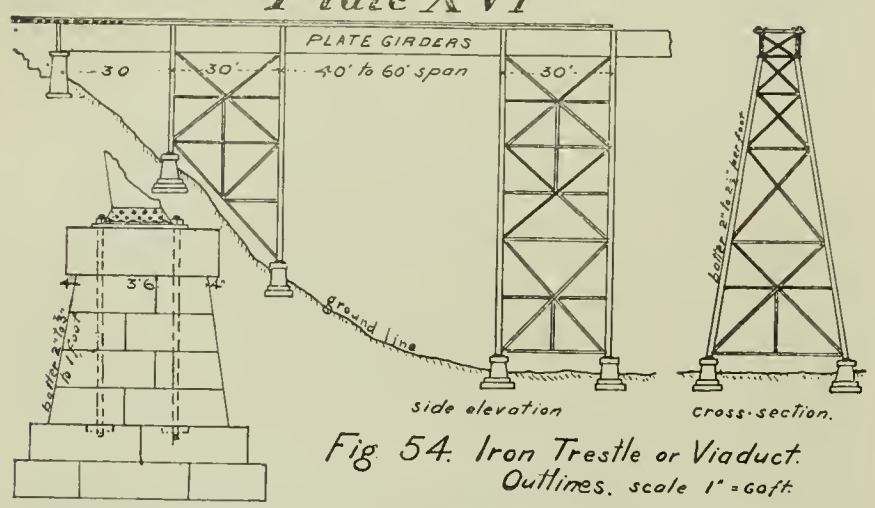
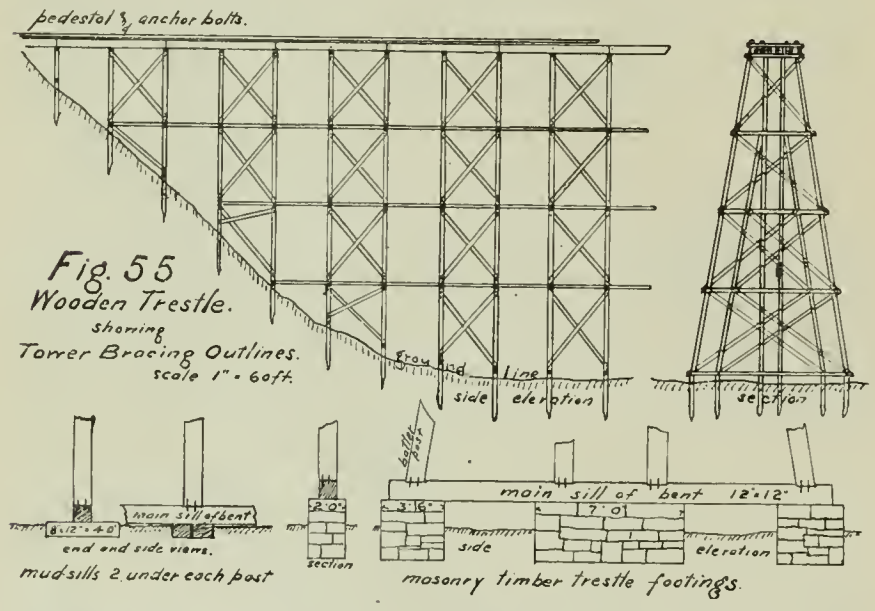
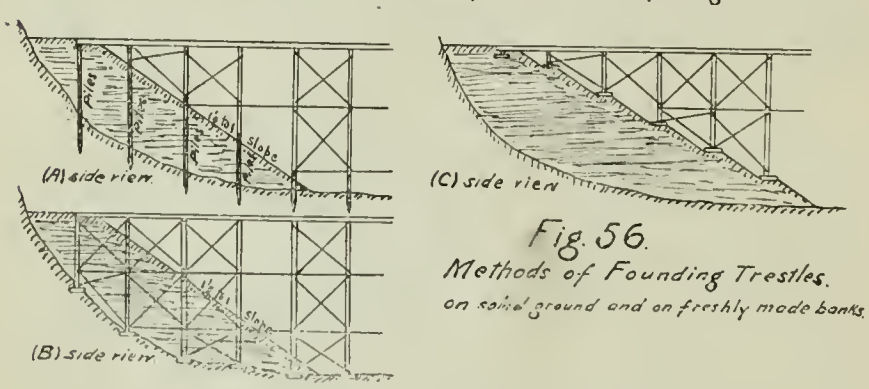


Fig. 54. Iron Trestle or Viaduct. Outlines. scale 1" = 60ft.





Article 26.—Wooden Trestles.

In America where timber is plentiful, cheap and widely distributed, where capital is often limited and construction hurried, and in inaccessible regions, the use of wooden trestles has been of great economic value. It is yet a factor not to despised; and although their design is apparently not very difficult, yet it should be thoroughly understood by the young railway engineer in its many phases at an early date in his practice. We have probably 100 feet per mile of railway in Canada, or about 300 miles altogether, and we may safely figure on a continual renewal of at least half of this every seven or eight years, which represents an annual drain on our forests for this purpose of perhaps 40,000,000 F.B.M., while the other half will be replaced by earth, stone or iron as fast as it decays. Gradual separation and sizes of timber available have produced several distinct types, each of which has its advocates; the greatest diversity exists in every detail from floor to foundation, and will be discussed somewhat, in order to obtain a broad view of the various methods in use.

(*a*) *Foundations.* — These may be classed as (1) masonry footings, (2) piles, and (3) mudsills.

(1) Stone work suitable for culvert walls is used for the masonry footings and will cost about $4 per cubic yard; the heaviest and longest stones should be used for the top course, and the sill well bedded on it in mortar. It is not necessary to bolt the sills to the masonry if the timber bents are braced longitudinally; and, sometimes, where it is anticipated that an iron viaduct will replace the wooden one at the first renewal, it may pay to build the batter post pedestals under every alternate bent, of first-class pedestal masonry, which will serve as pedestals for the columns of the iron viaduct when needed (see Fig. 56).

(2) When foundations are deep or soft, or less expense is desirable, a pile is driven under each post of each bent, and the sills rest on and are drift-bolted or tenoned to the piles; for 15-foot bents and a 100-ton engine, a pile will carry one-quarter of the load on a bent when it penetrates less than about two inches under a blow from a 2,000-pound hammer dropping 25 feet; but if such a penetration cannot be obtained without great depth of pile-driving it may pay to use more piles. (See Fig. 55.) Whenever a trestle is less than 15 feet high, framed bents may be dispensed with, and the piles left driven up to the bottom of the caps on which the stringers rest, in which case the outer piles are driven to a slight batter, and then pulled in, as the cap is drifted on, to a total batter of two or three inches per foot, or if the bent is only five or six feet high the piles may be all driven vertical; in either case, the centre piles are five feet apart and directly under each rail; usually a pair of × or sway-braces is bolted onto each bent, but no longitudinal braces are necessary. It is not good practice to build these pile trestles over 15 feet high unless for temporary work, as the vibration from traffic loosens the piles, and the rot at the ground surface is rather rapid and wasteful of material cut off, in case of renewals.

(3) *Mud Sills or Bank Sills.*—These consist of six or eight short cross-sills under the main sill of each bent, the usual dimensions are 8x12 inches by 5 feet long laid on flat, unboxed, which facilitates shimming by means of planks or boards under the main sills, and the bents will not get out of plumb if longitudinal braces are used. (See Fig. 56.) Other special foundations are:—Cribwork filled with stone where there is a current of water, a grillage or floor of timber in case of soft submerged ground, and holes cut in the rock, carrying the ends of the posts without any sill on steep solid rock side hill.

(*b*) *The founding of end bents.*—This is generally a difficult problem, as the freshly made embankments at each end of the trestle settle rapidly. Fig. 56 shows the three methods in ordinary use. Of these (*A*) is undoubtedly the best, but most expensive, as pile driving on sloping banks costs considerable; such piling should be done after allowing the bank to settle as much as possible, and the piles should be well driven into the solid ground to prevent them being shoved out of place longitudinally. (*B*) This method is pernicious, the embankment always contorts the trestle, no matter how well braced, the posts rot off at the ground surface, and it is also expensive and often delays the construction of the embankment; it has little to recommend it, unless the whole trestle is to be soon filled in. (*C*) This is seemingly a flimsy method, but is found very satisfactory in mild climates at least. Each

bent is supported on eight or ten mudsills, and as the bank settles a bridge gang surfaces and relines the trestle by shimming between the bents and bank-sills; after a few months, when the bank has become firm, very little attention will be required, and it is always convenient for repair or renewal, and nothing rots but the mudsills. It has also the especial merit of providing an elastic and gradual approach from the rigid trestle to the sinking fresh bank, which the first and second methods do not present. It is the cheapest method, and its only demerit is that it is affected by frost in the spring in cold climates.

Plate XVII

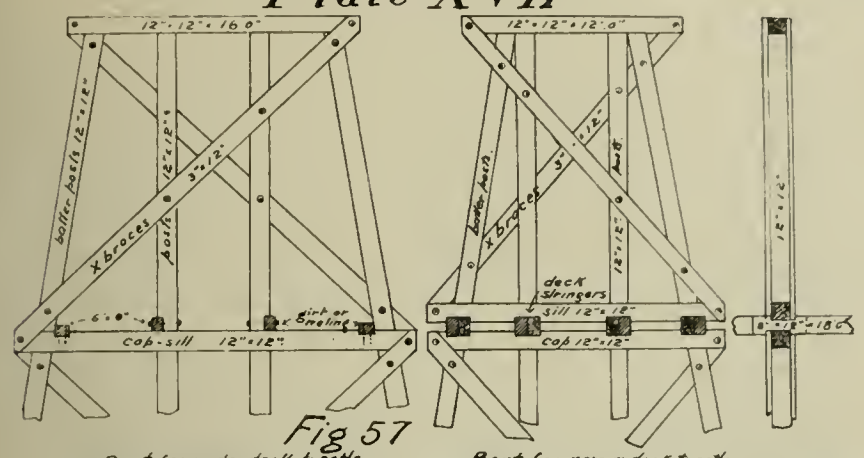


Fig 57

Bent for wide-deck trestle with cap sill and girts for longitudinals

Bent for narrow deck trestle with separate stories and deck-stringers.

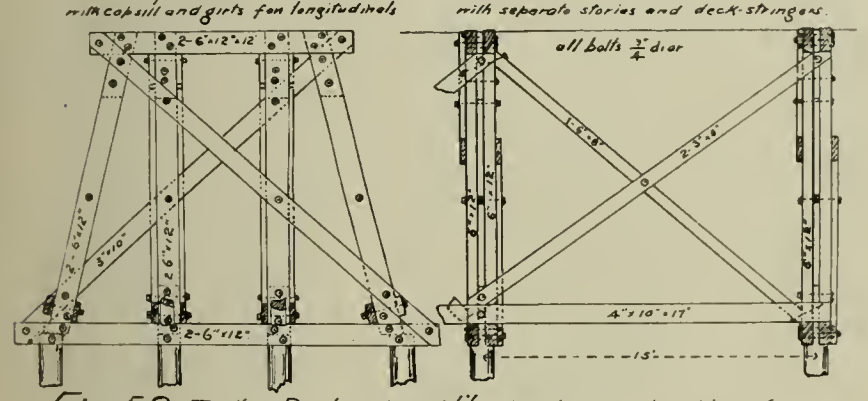


Fig. 58. Trestle - Bents using split cap sill and posts 2 pieces 6"x12"

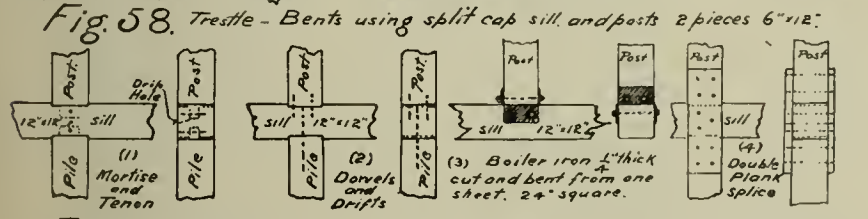


Fig 59. Methods of connecting posts with caps and sills.

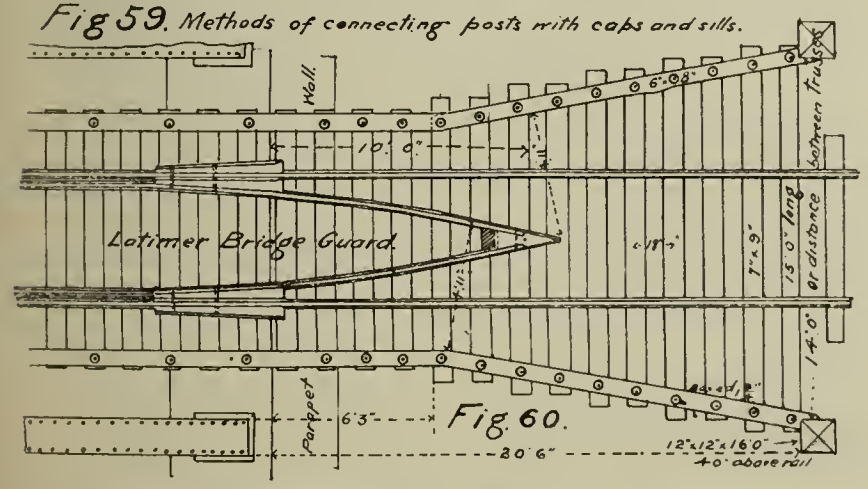


Fig. 60.

(*c*) *Trestle Bents and Systems.*—The ordinary styles of bents are with four posts, which are increased to six posts in very high trestles, each story or deck being braced by one or two pairs of cross or sway braces—the plumb posts being five feet apart, and batter posts sloping at from two to three inches per foot.

The longitudinal braces consist of cross braces and horizontal ties. The former are so grouped as to form towers and spans alternately, but the horizontal ties run the entire length of the structure. Speaking generally, low trestles on tangents need very little longitudinal bracing, while high ones on sharp curves need very much; between these two, the extent, disposition and sizes of such bracing will be a matter for the judgment of the designer, but all such braces should be bolted and not spiked, as vibration from trains will soon loosen the latter, and even bolts from the same cause and from shrinkage of timber need to have their nuts tightened two or three times before the rust locks them into place. Sway braces may, however, be partially bolted and partially spiked with pressed spikes.

The posts, caps and sills are usually of solid timbers 10 inches by 10 inches, 10 inches by 12 inches or 12 inches by 12 inches in section, the latter being most common. (See Fig. 57.) And such timbers make the best structures; but large timbers are often hard to obtain at reasonable prices, and in such cases, the style shown in Fig. 58 is found satisfactory and is easy to repair and renew. The split caps, sills and posts are usually 6 inches by 12 inches well bolted together; but the cost of such bolting, and danger of some of the bolts working loose are objections to the system. On the other hand, water is not so apt to lodge or rot where timbers are so narrow. An extension of this system is the "cluster bent" trestle, the posts being of four pieces of 6 inches by 6 inches, breaking joint and bolted to split caps and sill, with the cross braces acting also as separators. This style is advisable only in localities where timber is obtainable only in small dimensions, and of poor quality, its advantage being facility of repair; while the trestle itself is not so stable or durable as if made with larger timbers.

(*d*) *Joints and Fastenings.*—Fig. 59 shows the best methods in use. The advantage of mortise and tenon work is the easiness with which repairs can be effected, but it is a favorite lodging place for water and one of the first points to rot in a trestle—a drip hole partly obviates this; mortise and tenon work costs about $1 per M.B.M., more to frame than other methods shown. The drift bolt and dowel method is superior to the first one in rigidity, durability and easiness of erection, but is hard work to tear down, while the third method, although not in common use, appears to be a very sensible joint; the fourth method is for temporary work only, and is fastened with 6-inch pressed spike which would work loose very soon; it is an expensive and clumsy joint, but saves timber from mutilation for a second using. Probably the best combination is a tenon at the top of posts and 2 dowels 8 inches by 1 inch diameter at the bottom, such a system avoids rot and enables posts to be easily renewed and replaced.

(*e*) *High Trestles.*—When trestles are higher than 20 to 25 feet more than one story or deck will be needed (see Fig. 57), these may be either in separate bents locked by deck stringers, or they may be in a continuous bent in which the sill of one bent becomes the cap of the one below, etc.; in the former case the four lines of deck stringers, about 8 inches by 12 inches, overlap and are boxed onto the caps and sills and gained into them, giving a lock joint. The structure is very rigid, is simple of erection and easy to repair, but needs more material than the latter method, in which the longitudinal bracing consists of four lines of girts or wallings about 6 inches by 8 inches, which are butt-jointed and boxed about 3 inches on to the caps or posts and also bolted; this method saves one cap and some timber in the longitudinals also, and the upper and lower sway braces may be fastened by the same bolt at the cap-sill, but the trestle is a little harder to erect and much harder to repair, it is, however, on the whole probably the preferable method of the two.

(*f*) *Floor Systems of Trestles.*—The floor consists of stringers, ties and guard rails, and should be completed by adding some form of bridge guard like that shown on Fig. 60, by which trucks not too far off centre may be brought back to direction and probably placed again on the rails, or, at any rate, carried safely across the structure.

In Canada the wide-decked trestle, with two main

nests of stringers and two jack stringers supporting ties 12 feet to 14 feet long, is generally used on standard gauge roads, partly to give room for snowplows inside the guard rails and partly for additional safety; this is nowadays further supplemented by two lines of guard rails, of which the inner ones are faced with angle iron fastened by countersunk screws.

The sizes of guard rails and ties are shown in Figs. 61 to 65; but it is a growing feeling that ties cannot be spaced too close for safety to prevent bunching in case o derailment. They should not be more than 6 ins. apart clear at most and preferably 4 ins., and every fourth or fifth tie should be spiked to the stringers, and all boxed from $\frac{1}{2}$ in. to 1 in. on to them. There are some, however, who claim that if ties are kept spaced by the guard rail, and are boxed down on to the stringers, that any further fastening is unnecessary; ties should be of oak or some durable hardwood, which will hold track spikes.

Plate XVIII

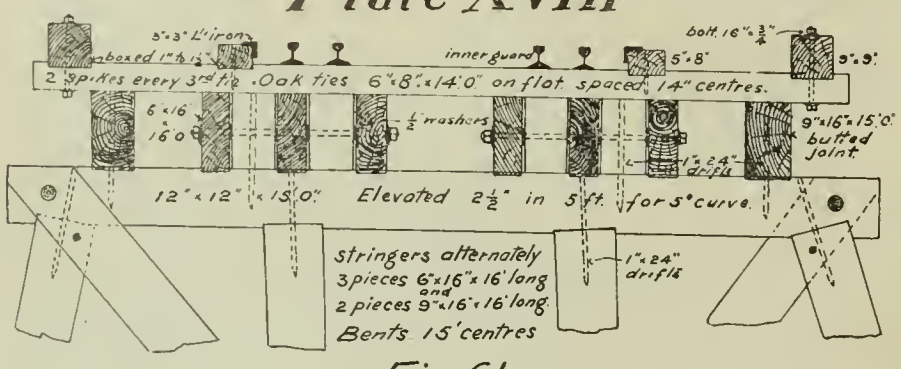


Fig. 61

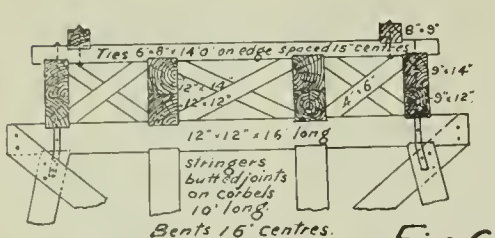
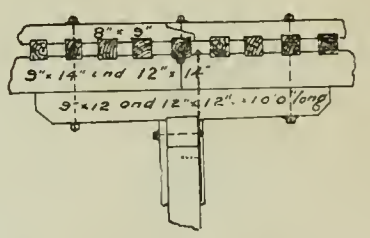


Fig. 62.



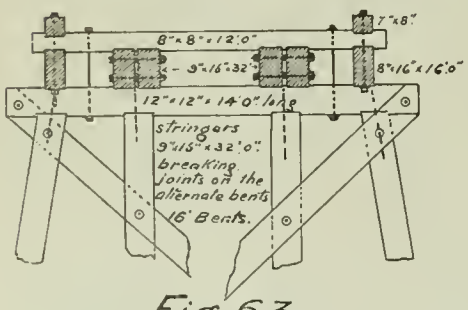


Fig. 63.

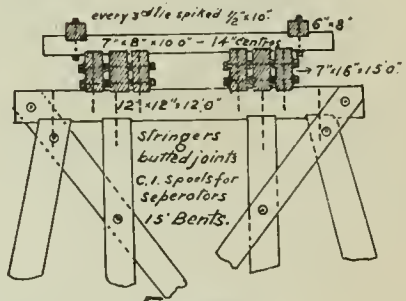


Fig. 64.

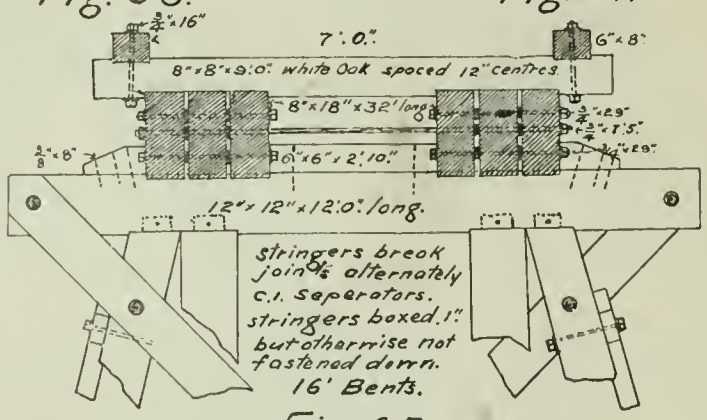


Fig. 65.

Cross Sections of Trestle Floors.

The guard rails should be of pine, or some durable wood that will not warp, and boxed down about 1½ inches on to the ties, so as to hold them apart, as well as to act as guard rails. They should be bolted on outer ones and spiked on inner ones to about every fifth tie. There are various styles of stringers; that shown on Fig. 61 is now almost standard for Canada. It consists of alternate groups of two and three stringers in two nests, one under each rail. These stringers are long enough to lap one foot and rest twelve inches on the caps, and are bolted together, but separated by cast washers to prevent rot, and each nest is drift bolted down to the caps. The outer or jack stringers carry very little of the load and are butt jointed, and also drift-bolted to the caps. The style shown in Fig. 62 is practically obsolete, being considered rather top heavy and demanding too heavy timbers; the corbels also give a very uncertain aid to the strength of the stringers. The style shown in Fig. 63 is used considerably in the United States. The stringers are 32 feet long, alternating with butt joints, and make a very stiff floor; but such large timbers are hard to obtain and harder to take in and out during renewals. One advantage, however, is that all ties will have the same boxings, while in Fig. 61, the length of boxing varies with each alternate bent—but the method of fastening the ties to the caps by long bolts is objectionable, such bolts will spring loose, and the heads would be cut off by the wheels of a derailed train. In the greater part of the United States, the narrow decked trestle, such as shown in Figs. 64 and 65 is very much used, there is an evident economy, the bents being narrower, the jack stringers omitted and only one guard rail, and that one close to the steel rails. It is claimed that such trestles with rerailing guards at each end, close spaced ties, and with an inside steel rail guard, are as safe as wider ones, and that a train which would derail so badly as to get outside the inner guards would leave the trestle anyway. Such floors are sometimes drift bolted down, or as in Fig. 65, held in place by a system of braces and rods—such a method having the advantage of facility of renewals.

(*g*) *Elevating Trestle Floors on Curves.* — This will amount to from a half-inch to five-eighths inch in five feet per degree of curve, and may be accomplished in various ways which are given in order of merit.

(1) Framing the bent with cap inclined to the required slope.

(2) Inserting an elevation or secondary cap on top of a level bent cap, and notching it down to suit the curve.

(3) Notching the main cap on light curves to receive the stringers.

(4) Placing blocks longitudinally under the ties and on top of the stringers.

(5) Sawing specially sloping ties.

(6) Placing strips or blocks under the steel rail but on top of the ties.

The sloping ties are, apparently desirable, but in renewals such a varied assortment is needed for trestles on various degrees of curve that it is an intolerable nuisance.

(*h*) The cost of trestle work is about as follows:

Cast-iron washers, etc.	2c. per lb.
Iron bolts, etc.	5c. per lb.
Framing and erection	$6 per M.B.M. (drift bolted).
" "	$7 " " (mortise and tenon).
Cost of timber	$17 to $27 per M.B.M.

A very ordinary price for timber now being $30 per M.B.M. in place, including iron; but in designing structures of this nature, by having due regard to the dimensions of timber which can be most readily obtained in any locality, the price may be held down, often somewhat lower than this, while sometimes a special price is put on stringers, which should be designed for the loads intended, and carefully inspected to see that they are up to the requirements, as they are the only members of the structure ever strained to their limit.

(*k*) *Quantities of Timber in Trestles.*—For very important and high structures, tables are of little value; but for ordinary use the following will give quite approximate quantities:—

TABLE XVI.

APPROXIMATE QUANTITY OF TIMBER IN TRESTLES PER 100 LINEAL FEET FOR VARIOUS HEIGHTS.

Narrow Deck, Timbers 10 in. x 10 in.			Lake Erie and Western.		Wide Deck, Timbers 12 in. x 12 in.	
Height.	F.B.M.		Height.	F.B.M.	Height.	F.B.M.
15 feet	17,000	1 story.	17 feet	19,400	10 feet	25,700
25 "	22,000		22 "	22,000	20 "	30,500
35 "	25,000		27 "	26,650	30 "	38,600
45 "	34 000,	2 stories.	32 "	29,640	40 "	47,000
55 "	44,000		37 "	34,780	50 "	55,200
65 "	50,000	3 stories.	42 "	38,080		
75 "	56,000		48 "	43,920		

WILLIAM OGILVIE, THE CANADIAN EXPLORER.

William Ogilvie, Assistant Astronomer to the Dominion Government, was born in Ottawa, April 7th, 1846, when that city was known as Bytown, and before it had become the capital of Canada. In early life he had very slender opportunities of education. Apart from the fact that the family were not in affluent circumstances, his father, though a worthy and sturdy Presbyterian, had imbibed the idea that every boy should not merely be self-made, but self-made without school education. He had read in a favorite book of the Smiles' "Self Help" order, of a

The Lancefield Abell Co. Photo.
WILLIAM OGILVIE.

poor boy who could not afford a lamp at night, and studied with a borrowed book, standing under the light of a corner lamp, and he fancied that his son should go through the same process in order to achieve success in life. The mother, however, took a more sympathetic view of her son's difficulties and ambitions, and it was through her influence that the youth, when he made up his mind to become a surveyor, was given a chance to devote his whole time, for about three months, to home study to prepare himself for his future profession. He apprenticed himself to a local surveyor, and in spite of poor and insufficient text-books, and his service under a man who having obtained a surveyor's commission at a time when the standard of qualification was very low, had no literary instinct, and rather discouraged book learning in those under him, Mr. Ogilvie successfully passed his examination, and was commissioned as surveyor on the 12th July, 1869. From the proceeds of his own labors the young man was enabled to continue and extend his self-education, and the small local practice he obtained showed such intelligent and correct work that he attracted the notice of Surveyor-General Denis. At this time a number of long-standing disputes among landowners near Ottawa came to a head. There had been a good deal of vagueness in the law bearing on these cases, and the tangle was rendered worse by differences in the interpretation of the law between the officials of the Department and the Cabinet. Mr. Ogilvie, who had already been instrumental in settling a number of disputes between neighboring land owners for whom he had done professional work, was now called in by the Government, and his interpretation of the law was not only sustained by the Minister of Justice, but his plan for settling the disputes among the aggrieved farmers was accepted on both sides. In spite of jealousies and intrigues against him, the intelligence and sound judgment shown by Mr. Ogilvie in the cases in question resulted in his being called on in 1875 to do regular work for the Government, and in 1882 he began that career of exploration which has reflected honor on the Canadian nationality and placed his name in the very first rank of modern explorers. His first work was done in connecting the great Peace River region with the Dominion Land Survey system, which occupied the years 1882 and 1883. In 1884 he made an exploratory survey of the Athabasca and Peace rivers and in the following year he surveyed the Canadian Pacific Railway at British Columbia as a base line for the land surveys of the railway belt. In 1886 he was engaged on longitude work by electric telegraph. In the years 1887 and 1888 he made the exploratory survey of the Yukon, Porcupine and McKenzie Rivers which was to add so much to his fame by reason of the gold discoveries, of which, at that early date, he realized the value. In 1890 he was engaged in astronomical work in connection with the northern boundary of the Province of Quebec. In this expedition a canoe journey of 1,500 miles was made to James Bay and the East Main River, a great deal of valuable geographical information being added to our knowledge of these regions by Mr. Ogilvie, who at the same time carried on astronomical work by observations of the lunar culminations there. The importance of his geographical work in opening to the ken of the world new tracts of country of continental vastness became recognized in Great Britain as well as in Canada, and in the spring of 1891 he was awarded the Murchison medal of the Royal Geographical Society for having made the most important explorations in the world at that period; his services in surveying the Canadian North-West Territories being particularly mentioned in the award. In the same year he made an exploratory examination of the north-east portion of British Columbia, and in the following year was occupied with surveys around Prince Albert, Sask. In 1893 he was engaged on important work in connection with the delimitation of the international boundary line between Canada and Alaska, and this work, with the Taku expedition in Northern British Columbia in 1894-5, and the projection of the 141st meridian through the Yukon in 1896-7, gave him a wide knowledge, not only of the great alluvial gold fields of the Canadian Yukon, but of the conditions of life among the miners and traders, and a greater insight into the general resources of this great northern land than is possessed by any living man.

In these later expeditions, Mr. Ogilvie was called on to do all sorts of work for all sorts of people. If a miners'

dispute arose, he was appealed to as umpire; if any man was suffering wrong, he besought Ogilvie's aid in obtaining his rights. His decisions were accepted without dispute, and the secret of his influence throughou this time of gold madness was that his motives were above suspicion, his judgments always founded on common sense, and that he took no part in the universal grab for wealth. In all the wild excitement following the fabulous finds of gold, there was one man who kept his head and went on with his scientific work as if all the gold lying about him was accounted, like silver in the days of Solomon, of no more value than the stones of the street It is one of the admirable traits of this noble type of Canadian official that he has remained impregnable to the sinister suggestions of avarice though confronted with so many temptations; and one of the highest tributes paid him in this respect was by a New York paper, known for its anti-Canadian prejudices. A strong sidelight is thrown on this phase of his character by a British Columbia paper, which thus speaks of Mr. Ogilvie's relations to the miners.

"While admitting that the investment of three hundred dollars a few months ago in a grub stake for two men, taking in exchange a half interest in their claims, would have resulted in his being worth a million dollars to-day, Mr. Ogilvie modestly disclaimed any credit for refusing to invest, and it is almost certain that had he known at the time, beycnd any possibility of doubt, tha the investment of the $300 would have been as profitable as it has proved, his course of action would have been the same. 'I had to act up there as a sort of arbitrator, and I was not willing,' said he, 'to place myself in a position where my personal interests might have influenced my judgment." 'Regret it?' Mr. Ogilvie continued, 'no, not for a moment. As for money, I have plenty to satisfy me during my life, and I cannot take any away with me out of this world. As for my boys, they must work their way, as I have done, and they will be all the better men for it.'"

An interesting testimony to his perfect fairness to all the miners, irrespective of nationality, was recently given at San Francisco, when he was on his way home from the Yukon. A number of returned American miners sought him out and presented him with a valuable gold watch, in gratitude for his just administration of the affairs of he Klondyke.

A study of the accompanying portrait reveals a face indicative of great determination and administrative ability tempered with benevolence. We believe that Ogilvie is a greater explorer than H. M. Stanley. Without any of the harshness and arrogance that marked Stanley's methods, Ogilvie has, though not making any noise in a literary sense, accomplished greater work, and posterity will be brought to admit it.

In the twenty-two years during which he has been in the Government service he has traveled 75,000 miles by rail, 14,000 by steamer (mostly by the crude river crafts in use in the Canadian North-West), 8,500 by canoe, 9,500 on foot and 4,000 by cart or buckboard, making a total of 111,000 miles traversed on his official journeys. Difficulties such as Stanley and other travelers have depicted in dramatic colors have been passed over by Ogilvie without a word in his reports, and if the full story of his vast and lonely journey could be told it would make most valuable material for the future history of the great north land of Canada. It is very distasteful to him, however, to dwell on his own achievements, and it is only from his official reports, made as a matter of duty to the Government, that we can piece together some notion of his deeds. Once only did Mr. Ogilvie condescend to give a popular record of some of his work, and this was in the *Canadian Magazine*, for which he wrote a series of sketches under the heading of "Down the Yukon and up the McKenzie," and "In North-West Wilds," which appeared in 1893-4. The narrative of these remarkable travels is so simply told and yet so instructive and entertaining that all who have read them have wished for more. In one part of his first ketch he pauses in one of those days of 20 hours Arctic

WILLIAM OGILVIE, FROM PHOTOGRAPH TAKEN ABOUT 1889.

darkness to reflect "more than 2,500 miles were still lying between us and the nearest railway station, nearly all of which had to be got over on foot or by paddle"—a simple statement, but how eloquent of trial adventure, and enduring patience! In his sketch of the exploration of the great Mackenzie basin, he gives us a picture of daily life at Fort Nelson. One of the incidents is best told in his own words:

"There were two very old Indian women living at the Fort on such food as they got from the (Hudson Bay) Company's employees. One was totally blind, and the other nearly so. A half-witted Indian boy cut their wood and attended to their wants, and by way of compensation they shared their food with him. No one knew their age, but they had lived a long time for natives, as evidenced by their wrinkled faces, lustreless eyes, and toothless mouths. Their clothing was very scant and very dirty, their hut 'a thing of shreds and patches,' little better than none; their food was often scant, and their fire low. You fancy them utterly miserable, but they were not. I called on them daily with some food, a bit of tobacco, and a few lumps of sugar. This would put them into wonderful humor, especially the sugar. The blind one would hold her sugar in her hand, occasionally licking a lump, and exclaiming, 'Eh, Shugow,' (sugar) in a tone which bespoke complete ecstasy. The feast always wound up with a jocular discussion by these ancient dames as to which of them would secure me for their sweetheart. They invariably appealed to myself to decide between them, each meanwhile affecting all the airs of a pronounced flirt, displaying her charms with the most ludicrous poses, which convulsed me with laughter. The manner in which I parried these requests for a choice between them amused them highly, and who could refuse to brighten the lives of such poor old creatures with a little harmless pleasantry? Once the blind one, through the aid of the interpreter, told me her life story, how she had lost several husbands and all her children by death, had no friends alive that she knew of, and was waiting patiently

to join the lost ones in the Great Beyond. Her poor old wrinkled face and sightless eyes bespoke acute sorrow during the recital, especially when she expressed her desire to lay down the burden of her life. I have never elsewhere seen such squalid poverty accompanied by such childish cheerfulness."

This is an admirable bit of word painting, which, while it brings before us a vivid view of aboriginal life as it really is, to us reveals the tenderness and sympathy of the man.

One who knows Mr. Ogilvie intimately, gave the writer this estimate of his character: "He has a high sense of honor and strong judicial mind; careful practical generalship, enabling him to execute difficult undertakings and secure large results where most men would utterly fail; faithfulness to trust and scorn of anything underhand; energy and endurance, especially a capacity for protracted, constant labor. Add to these qualities his genuine good nature, his great knowledge of men and life, especially frontier life, and you have a man who is easily first among Canadian explorers, and I believe that only his modesty and disinclination to be 'boomed' has kept him from world-wide fame."

SILVER IN THE OTTAWA VALLEY.*

On Calumet Island, in the Ottawa River, some research work was done last year on the deposits of blende and galena, noted there for some years, and mining licenses were granted on several lots. On lots IV½, N.W. 10 and 11, the old Russell property, Charles B. Watts and others, of Toronto, have prospected from the end of last winter, with 10 to 15 men; some work was done on this mine by the first proprietors, who established the presence of important deposits of blende and galena, an assay of which gave zinc, 40 per cent.; lead, 12 per cent.; silver, 15 ounces per ton. The actual works have brought to light new indications, especially on lot 10 near the line of 11, where at a depth of 45 feet a deposit of blende several feet thick can be followed for a distance of 80 feet, from which 200 tons were extracted, 50 of which are still at the mine. It was on lot 11, near the line of 12, that a deposit of galena was worked two years ago.

Charles Meyer and others, of Belgium, under the name of the Grand Calumet Mining Co., control the properties IV½ S. 9 ½, S. 10 and 12, and have prospected since spring with six or seven men. On lot IV., 12, in the vicinity of the pocket of galena above mentioned, they sank a trial shaft, which was not more than fifteen feet down in September. The surface indications show a band carrying blende and numerous specks of galena. The same company has also prospected on lots 9 and 10, where some blende was found. On 10, galena in fine grains is found in the diorite. I understand that if the prospects are satisfactory this company will arrange for the regular working of this mine, and will establish concentration works. It intends to work this winter with steam engines and drills. On the central part of lot IV., 9, Colin Campbell has cleared away the surface and laid bare a remarkable exposure of solid blende, with a width of 40 feet by 12. It is probable that this ore body has greater extension, as the rock has only been laid bare on this part, and the walls are not visible. In the southeast part of the same deposit there is also a fine indication of galena, of which a sample, taken by J. Obalski, and assayed, gave 103.82 ounces of silver and strong traces of gold, the whole representing $60 worth of precious metals. On lot 8 of the same range he also prospected and found indications of blende disseminated in the quartzite. He has worked since this summer with four men only.

The southern part of Calumet Island where these deposits are found, belongs to a strip of rock called the Upper Laurentian by the Geological Survey; the northern part is Laurentian. A mineral band seems to exist there, accompanying an eruption of diorite running in a N.N.W. direction, as shown by the croppings and rusty rocks, and by the few prospects above mentioned. The width of this band does not seem to be less than 200 to 300 feet, and it is claimed that indications have been found between lots IV, 8, and VII, 27, where the seam ores have been noted, thus giving a course of about four miles. The ore body is of blende, slightly mixed with galena, and carrying a percentage of silver to the extent of about 15 ounces to the ton. Occasionally, the galena occurs alone, as on lots IV, 8, 11, when its proportion of silver rises to 146 ounces per ton, according to assays which I caused to be made, and even more according to other assays; small threads of native silver are also found. It is impossible to say to what depths these deposits extend, but it is possible that the galena grows more abundant, when they would become profitable to work. The shipping points are at Clark Station and at Campbell Bay, on the Pontiac and Pacific Junction Railway, at six or eight miles from the mines. The ground is not very rough, is partly occupied by farmers and supplied with good roads. The Government still owns the mining rights of a portion of this territory, as well as the rights everywhere to the precious metals.

* Extracted from the report of J. Obalski, C.E., to the Commissioner of Colonization and Mines of the Province of Quebec.

THE MOTOR CAR INDUSTRY.

The interview with Dr. Doolittle, which was published in the January issue of the ENGINEER, gives a very valuable outline of the present condition of the motor industry in Britain. None of the points he touched upon were elaborated, as the subject is such a many-sided one that it would require too much space. One criticism he made, however—namely, the exploitation of the industry by professional promoters for revenue purposes only—deserves fuller mention.

The Great Horseless Carriage Company, one of the off-shoots of the British Motor Syndicate, has been the victim of the most malign manipulation by promoters, and as a result its affairs are in a tangle. It is difficult to understand how level-headed Englishmen could have been wheedled into investing their money in a concern which had no business basis, the agreement upon which the company was formed having been so worded that it had no right to new patents issued since May, 1896. This means that, with their charter powers, the company must make carriages only from old patents that have been superseded; that it cannot make Daimler motors nor De Dion motors—these two being the most popular at the present time in Britain; nor can it make any cycle motors whatever. It is doubtful whether it can make a motor carriage to-day that would sell. In the course of litigation it has appeared that H. J. Lawson was the promoter and the sole acting director of the Great Horseless Carriage Company, and he had virtually also control over the British Motor Syndicate.

A committee of the Great Horseless Carriage shareholders has been formed to consider plans for the future of the company. Their report is lengthy and intricate, and need not be followed, except so far as it touches the main point dealt with in our interview in reference to the position of the motor car industry. For the purpose

of enquiring into the future of the industry some members of the committee went to Paris, where (never having been under government restrictions) the industry was making progress at the time prior to the passing of the English Act in Nov., 1896. They went through several large factories, each employing some hundreds of hands, and in most cases with order books full for many months ahead, and preparations for many large motors to increase the output. The principal motors in use were the Daimler, manufactured for vehicles by Panhard-Levassor & Peugeot, and the De Dion for tricycles, in which latter much business will certainly be done. A little attachment to their tricycles to hold two people is just out and becoming popular. It is also said that motor traction is being adapted to the French navy, postal service and army. The members of the committee returned quite satisfied with the progress and future of the industry in France. A visit was then paid to Coventry, where the Daimler Co. is now turning out several motors weekly; the Beeston Cycle Co. are making the De Dion tricycles, and the Humber Co. is starting with a regular output. Electric cabs are running satisfactorily in London, and a mail motor van is now undergoing long distance tests. In Scotland a line of motor cabs at Hamilton is working successfully, another at Blackpool, England, and cars are now under construction for two other lines to be opened in Scotland. There is of course a great deal of prejudice to contend with, but notwithstanding this the facts showed to the committee's satisfaction that the industry has come to stay; and the committee expresses the conviction that so soon as motor vehicles with all the latest improvements are turned out in quantity from the regular patents to enable them to be put on the market at reasonable prices, a motor manufacturing company will pay.

For The Canadian Engineer.

DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON.

(Continued from last issue.)

At Liverpool, Eng., the refuse destructors are of the Manlove, Alliott & Fryers slow combustion type, divided into cells (as the furnaces are called in England) about $2\frac{1}{2}$ feet wide and 5 feet from front to rear. The refuse, which is of a very objectionable and filthy kind, is fed from the top, through holes at the rear end of furnace; the smoke and fumes from the fire are drawn off at the same place and pass over the damp, green refuse before entering the flues, for the purpose of drying the rubbish prior to arriving at the fire grate to be burnt. Only natural draught is applied by using a long chimney, and the temperature of the fires seldom exceeds 700° Fahr. On this ground the gases and fumes drawn off the fires must be cremated by passing them through a high temperature furnace, called a Jones' cremator, before being allowed to pass up the chimney to be discharged into the atmosphere. The weight of refuse, or garbage, which consists of mixed night soil, ashes, sweepings from paved streets, and house garbage, is reduced by 67 per cent. by the process of burning, yet the residue of clinker and ashes is not burnt sufficiently hard, and, therefore, of small value for ballast, etc. They have the same type of furnaces at Birkenhead, but have so altered the designs of the smoke flues that in place of being discharged at the rear end and the heat passing over the wet rubbish to assist in drying it, preparatory to being placed on the furnace, the fumes and gases are drawn out at the front near the clinkering door, with the object of compelling the fumes cast off by the roasting refuse to pass over the body of fire on its way to the collecting flues. This method partly consumes the poisonous gases. At Salford they also use the Manlove & Co. type, which they have so altered that they have increased the daily consumption of refuse by making a slight alteration in the feeding holes, and constructing their flues in a way that the flames and gases are collected and pass out at the centre of each cell or furnace, in place of being discharged at the rear or at the front end, as before explained. This method is stated by visitors and experts to be the most perfect low temperature, slow combustion furnace, working by natural draughts. But a great many of these furnaces are being made into high temperature furnaces of over 2,000° F., by applying forced draughts. Sometimes fans are used, but raw air is not the draught suited to burn rubbish, because the dry air forces part of the foul fumes forward past both the fire and combustion chambers, unburnt. When a mixed steam and air blower is used, the steam attracts and absorbs the poisonous fumes, and together with the heat of the furnace, destroys or purifies them, so that the gases can be freely discharged into the atmosphere without the aid of a fuel-burning cremator or a tall chimney.

By the slow combustion process, only seven tons can be burnt in 24 hours. When a strong forced draught is properly introduced with a few detail alterations, as much as 15 tons can be burnt in the same space of time, making a harder and better burnt clinker and ash, and reducing the weight of the residuum to about 25 per cent., while the low temperature process can only reduce it to 33 per cent. At the rural village of Withington, the destructors were built from their own surveyor's designs. They consist of six low temperature furnaces, a fume cremator, a chimney 150 feet high, engine, boiler, dynamo, motor mill' etc., the total cost being £3,400. At the bottom of the chimney stack double wire screens are fixed to prevent anything unburnt from being drawn up the chimney. At Cambridge they use Manlove's Destructors, and use the heat for generating steam that creates power sufficient to pump the town's sewage. They also have a dual system at Baildon. Their refuse destructor is of a slow combustion type, with a low temperature, so that the rubbish, ashes, night soil and garbage are only carbonized *and not burnt to an ash.* Each cell or furnace place is fed in at the rear of the fire bars, the rubbish sliding down an inclined plate from the tipping floor. The air or smoke pipes are carefully and mechanically adjusted in a way that the fire is almost smokeless, because loss of smoke means loss of carbon. They are fixed in the side walls near the front door, drawing sufficient to give the furnaces the right quantity of air to allow the refuse to carbonize, but not to burn sufficiently to make smoke. The residuum is a mixture of soft clinker, cinders and powdered charcoal, which are carbonized in this way under a patent for the purpose of using the residuum for a filtrate to purify the town's sewage, it being found to be the most suitable material. In this way Baildon cleans and purifies the town's sewage with the foul refuse, thus using one public nuisance to destroy another.

The Bradford corporation has the Manlove, Alliott & Co. furnaces, improved and altered to come up to the times, and as I before pointed out in the January issue, the fumes from the drying refuses pass over the fire, up through holes in the firebrick screen (which forms the arch over the fire) near the door, then through its own combustion chambers, passing along to the large collecting vault, thence through the flues to the steam boilers, from them through the economizers, afterwards finally passing out at the chimney. The combustion chambers and large vault

being always near a white heat, the gases from all the twenty furnaces get reburnt and well mixed together, causing a high temperature and an increase in the number of units of heat useful for steam raising purposes, proving that plenty of good brick work, well put together, scientifically arranged, so that it divides the particles and mixes the gases, expanding and increasing them, is a good investment because it largely assists in extracting all the injurious fumes from the discharged gases and nearly doubles the number of units of heat used for raising steam.

(*To be continued.*)

CANADA HOLDS HER OWN.

The question of how best to reach the golden North has been decided by the Dominion Government, after consideration of the reports of engineers W. T. Jennings, Wm. Ogilvie, and others. The press of the United States has been most active in suggesting methods by which Canadians might be harrassed on their way to mine Canadian gold on Canadian lands. It has been found possible to make entry through United States ports troublesome and expensive—the people of Seattle and other western towns have thought that in this way they could capture the outfitting trade. The natural result has followed, and the Dominion Government has chartered a railway which will give us an all Canadian route to the Yukon country. Reference to the accompanying map of Alaska and the Yukon territory shows us the stretch of 150 miles between Telegraph Creek and Teslin Lake, which the McKenzie and Mann railway is to cover. The mouth of the Stikine River, as it is now officially known, is in the United States, but the free and uninterrupted navigation of the river, and every other on the coast, is guaranteed to British subjects by treaty.

metals produced from the lands alienated to the company, as compared with 10 per cent. imposed upon ordinary placer mining. The contractors are not to receive a cash subsidy, but, on the other hand, are required to put up a deposit of a quarter of a million of dollars as a guarantee for the execution of their contracts. No portion of the beds or of the banks for 25 feet on each side of high-water mark shall pass to the contractors under any selection of lands to be made under the agreement. The shores and all landing places, few and far between in that rugged, rock-ribbed country, and therefore very valuable, are withheld, and the free rights of passage and use along all navigable or floatable streams may not be impeded or obstructed by the company, and are absolutely reserved to the people. In case the contractors divert any stream from its natural channel, they must provide an equally convenient navigable or floatable channel in lieu. All mining claims held and recorded by free miners within any block of land selected by the contractors, shall be excepted from the grant, and shall not pass to the contractors. The tolls to be collected on the railway between Stikine River and

The details of the agreement between the Dominion Government and McKenzie & Mann, as given to the public, is summarized below. The agreement provides for the construction of a railway from the Stikine River, in British Columbia, near the mouth of Telegraph Creek, Glenora, or the mouth of the Clear Water River, northward to Teslin Lake, a distance of about 150 miles, thus giving connection with the Lewis or Yukon River, and an all-Canadian rail and steamboat route from a port on the Pacific coast to Dawson City. This road must be completed and in operation by September 1 next The contractors must also construct a practical sleigh road from the mouth of the Stikine River to Teslin Lake, and provide suitable shelters and stopping places for travelers at intervals of not more than 25 miles along this road, and the road and shelters must be available for use not later than six weeks from now. The contractors must also provide steamboat transport of freight and passengers between Teslin Lake and Dawson City. The Government proposes to grant 25,000 acres a mile of mineral lands, or 3,750,000 acres in all, to the contractors. The lands shall be selected from the Klondyke provisional district, and from that part of the North-West Territories lying west of the Mackenzie River and Liard River and north of the 60th parallel of latitude But it is provided that all arable land shall be reserved. It is also provided that in determining the selection of lands for the contractors, each alternate block shall be reserved for the Government. In addition a royalty of 1 per cent. will be laid upon all the precious

Teslin Lake will be first fixed by the Governor-General-in-Council, and, as so fixed, shall not be liable to reduction for four years. They shall then be reduced by 25 per cent., and after the road has been operated for seven years there shall be a reduction of 25 per cent. on the tolls as previously reduced, and after the road has been ten years in operation the tolls shall be subject to the general railway law of Canada in that behalf. The lands granted shall be free from taxation for ten years, except municipal taxation by an incorporated city, town or village within the Klondyke provisional district. When any ten continuous miles of the railway have been completed, the contractors may select 92,168 acres, or two blocks of land, and these blocks shall thereupon be reserved from sale or location, or free miners' claims, and on completion, from time to time, of any other ten miles, the contractors shall have the right to select two additional blocks, and on the completion of the railway, the blocks so reserved shall be granted to the contractors, with the exception of any existing free miners' claims, which shall be held inviolate. For five years from Sept. 1st, 1898, no line of railway shall be authorized by Parliament to be constructed from Lynn Canal, or from any point near the international boundary between Canada and Alaska into the Yukon, nor shall any aid in money or land be granted to any other contractors for this purpose. Moreover, during ten years from Sept. 1st, 1898, the contractors shall be given the preference in any aid the Government may see fit to grant towards the building of a line of railway from the Stikine River to an ocean port in British Columbia, provided they are willing to undertake the construction within a reasonable time.

MACHINES.*

A machine is an instrument by means of which a force applied a one point is able to exert at some other point a force differing in direction and intensity. It has been usual in treating of simple machines to call the force applied power; but the word power is now in use with an entirely different meaning, and so we shall accordingly speak of the applied force as the effort. The force exerted, or effective resistance overcome is usually called the weight. This resistance may be the earth's attraction, as in raising a heavy body, or it may be the molecular attractions between the particles of a body, as in stamping metal or dividing wood, or it may be friction, as in drawing a heavy body along a rough road. Besides the effective resistance, the effort is employed in overcoming the internal resistances, chiefly due to friction between the different parts of the machine. The effort may be just sufficient to overcome these two kinds of resistance, or it may be excess of what is necessary, or it may be too small. If just sufficient, the machine once in motion will remain uniformly so, or if it be at rest, it will be on the point of moving, and the force applied or effort will be in equilibrium with the effective and internal resistances. If the effort be in excess, the machine will be set in motion and continue to move with an accelerated motion. If the effort be too small, it will not be able to move the machine, and if the machine be already in motion it will gradually come to rest. When the effort is just sufficient to overcome the resistance, the ratio of the resistance to the effort is called the modulus of the machine. In this case, it is evident from the law of conservation of energy, that the work done by the effort has its equivalent in the work done against the effective resistance to be overcome, and against the resistance due to the friction between the parts. This is the general law of machines in motion or in equilibrium.

The ratio of the effective resistance, which we call simply resistance to the effort, is equal to the ratio between the distance through which the effort acts, and the distance through which the resistance is overcome in the same time, or, in other words, is equal to the velocities of the points of application of the effort and resistance; or, if we take equal distances and uniform motion, we see that what is gained in force is lost in time.

Simple machines, sometimes called the mechanical powers, may be considered under three heads: 1. A solid body movable around a fixed point; 2. A flexible string; 3. A hard inclined surface. Under No. 1 come machines acting on a lever, and wheel and axle, such as the crowbar, etc. In this case the difference between the power and fulcrum is greater than the difference between the fulcrum and weight. In the case of the wheelbarrow, row boat, etc., the power is at one end, the fulcrum at the other, and the weight between the two. In the human arm the weight is at one end, the fulcrum at the other, and the power between. Under No. 2 come pulleys. In the case of the single pulley the power exerted must be equal to the weight; it simply changes the direction of the force. Where more than one pulley is used, as in one block, the first one would support the whole weight, which we will say is 100 lbs.; the second pulley would support one-half of what is supported by the first, or 50 lbs.; the third would hold or support one-half of what is supported by the second, or 25 lbs. The force, therefore, required to lift the 100 lbs. would only be equal to 25 lbs., but, as it has been already said, what is gained in force is lost in time. No. 3, inclined surfaces, including the wedge and screw. To take a weight up an inclined plane, the weight and height must be equal to the power and length. In the screw the power and circumference equals the weight and distance between threads.

* A paper read before the Hamilton Branch, C.A.S.E., by Jas. Gill, teacher of Physics, in the Normal College and Collegiate Institute, Hamilton, Ont.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during December, 1896, 1897, and the twelve months to December, 1896-1897.

	Month of Dec.,		Twelve months ending Dec.,	
	1896.	1897.	1896.	1897.
Hardware and cutlery	£3,557	£4,327	£62,382	£68,144
Pig iron	60	225	28,026	9,434
Bar, etc.	386	263	15,540	8,892
Railroad	36	..	174,470	45,789
Hoops, sheets, etc.	2,473	112	49,435	77,935
Galvanized sheets	1 606	5,185	56,013	57,955
Tin plates	31,217	7,149	184,043	224,570
Cast, wrought, etc., iron	1,528	4,625	49,286	36,604
Old (for re-manufacture)	..	170	15,758	7,854
Steel	3,001	3,946	88,394	55,902
Lead	1,777	978	18,128	28,370
Tin, unwrought	1,152	3,356	21,103	20,725
Cement	8	2,701	32,731	22,498

TESTS OF CAST-IRON COLUMNS.*

We present herewith a report of the tests of full-sized cast-iron columns recently conducted by the Department of Buildings of New York city at the works of the Phœnix Bridge Co., Phœnixville, Pa., under the direction of W. W. Ewing, of the department. The tests began on Dec. 15th at 1 p.m., and were finished on December 21st. The machine used was the testing machine at the Phœnix works. To ensure the accuracy of the tests, the Building Department arranged a comparison of the Phœnix machine with the famous Emery machine in the United States Arsenal at Watertown, Mass. On December 30-31, 1896, a series of compression tests was made at Watertown upon a soft steel Phœnix column built by the Phœnix Iron Company especially for these tests. It was made of eight segments riveted together, forming a round column 21 feet long, inside diameter 14⅝ inches, thickness of metal 1⅛ inches, area of section 75 3 square inches, total weight of 5,485 lbs. The calculated safe load was 530 tons. The column was shipped to Watertown Arsenal and carefully tested in the Government machine shops at that place. Marks were made 26 inches from the ends, that is, 200 inches between marks, and a form of roller extensometer reading to 1-10,000 inches, was employed, to take all measurements. In applying the load constant increments were used. Certain additional loads were applied, corresponding with those to be applied later in the Phœnix machine. The column was then returned to Phœnixville, and the tests repeated in the Phœnix machine. The conditions were reproduced as nearly as possible; the same series of readings were taken, using the same extensometer. The results of the two tests are shown in Tables I. and II.

The gauge used to calibrate the Phœnix machine was a mercury column instrument, manufactured by Thomas Shaw, of Philadelphia, Pa., and numbered 5,447, was calibrated to read in pounds per square inch, and ranged from 0 to 220 lbs. The pressure used in the cylinder of the hydraulic testing machine is received on a diaphragm and transmitted to the lower end of the double-headed piston, whose upper end, of much greater diameter, is surmounted by another diaphragm, above which is a reservoir of mercury, and a mercury column of small bore. The actual tests were made with a higher reading mercury column which was compared with instrument No. 5,447 at the time of the tests, and afterwards by the maker of both instruments.

From the figures thus obtained the following computation of the calibration of the Phœnix testing machine was made and included in Mr. Ewing's report:

Let P = unit load in Watertown machine.
l = compression in ins. due to P.
P' = unit load in Phœnix machine.
l' = compression in ins. due P'.
P = 1 lb., l = .0000000891, and l' = .0002432916.
If $P : P' = 1 : l'$

then $\frac{P}{P'} = \frac{l}{l'}$, and $P' = \frac{P\,l'}{l}$

$$P' = \frac{.0002432916}{.0000000891} = 2{,}730.54 \text{ lbs.}$$

* Reprinted from the *Engineering News*.

This figure indicates that each unit on the gauge must be multiplied by 2,730, to obtain the pressure exerted in lbs.

TABLE II.

COMPRESSION TESTS OF CAST-IRON COLUMNS MADE FOR THE DEPARTMENT OF BUILDINGS, NEW YORK CITY, IN 1896, BY GUS. C. HENNING, M. AM. SOC. M. E.

No.	Length.	Outside diameter, inches.	Thickness — Maximum.	Thickness — Minimum.	Thickness — Average.	Breaking load, actual gauge-reading, lbs.	Sectional area, sq. inches.	Breaking load per sq. in. lbs.	*Corrected breaking load per sq. inch.
1	147¾ inches.	8	13-16	⅝	¾	520,000	17 08	30,400	25,840
2	150 "	9	1⅛	¾	1	630,000	25 14	25,100	21,340
3	162 "	12	1	1	1	1,250,000	34·55	36,200	30,770
4	159¾ "	14	1⅛	¾	1	1,226,000	39.84	30,700	26,100

* The figures in this column are obtained by deducting 15 per cent. from those in the preceding column, for friction of the machine.

We come now to consider the results of the breaking tests of the cast iron columns. Ten columns were tested, six of them being 15 feet 10¼ inches long, 15 inches diameter, and from 1 to 1 3-16 inches thick; two were 13 feet 4 inches long, 8 inches diameter, and two were 10 feet long and 6 inches diameter. A condensed table of results, Table III., is given herewith, the last two columns of which are from our own calculations, and are not given in the Building Department report, which gives only the actual data obtained without drawing any conclusions.

From the observations reported by Mr. Ewing, we quote as follows:

Column 1—Column suddenly broke under a total load of 1,356,000 lbs. into 10 pieces; the fractured surface began about 3 feet 4 inches (average) from the bottom.

The quality of metal was medium grain; foundry dirt and blowholes were quite numerous; in one place the foundry dirt extended half way through the metal; in another place, there was a thin layer of foundry dirt and honey-comb midway between the inner and outer surfaces; between this layer and the two surfaces, the metal was perfectly sound: this layer of foundry dirt contributed to the weakness of the column, as was evident from an inspection of the fractured surface.

The column sheared at an angle of about 30° with an element of the surface, and about 45° with a normal to the surface, inside of the layer of foundry dirt, above referred to only. This layer of foundry dirt extended about 6 inches around (circumference) on column. At another fractured surface where no defects occurred, the metal sheared along a spiral course about 45° with an element of the surface, and at an angle of 45° with a normal to the surface; this surface was about 15 inches long.

Column 2.—The column crushed near the lower end, many of the pieces being quite small; the bottom flange was left intact, the fractured surface beginning at the top of the flange or 1¾ inches from the faced end of the column and extending around the shaft in an irregular manner, reaching 5 inches away from bottom flange in one place

The shaft of the column above the fractured portion was found to be permanently sprung ½-inch in a distance of 9 feet 4 inches along shaft. The quality of metal at bottom of column, where fracture occurred, was medium grain and quite uniform in grain. Considerable quantities of foundry dirt was found at fractured surfaces and where the column crushed into small pieces, the foundry dirt extended all the way through in many spots.

The shaft sheared in several places at an angle of about 45° to the elements of the surface of the column parallel with its axis, the fractured surface following a sort of spiral path around the shaft. The metal at the same time sheared through at an angle of from 30° to 45°, with a normal to the surface of column.

Column B 2.—The fractured portion of column was below the centre, beginning 3 feet 9 inches from bottom and 6 feet 6 inches from top of column. Quality of metal rather course, but quite uniform. Flaws occurred in spots, but not bad. There was evidence of shear at 45°, the same as in preceding columns.

Column B 4.—The quality of metal was rather coarse in centre of shell, and somewhat finer toward the surfaces. Cinders and slag in considerable quantity, two bad spots nearly opposite at bottom of column where metal was poor; one of these was 5 inches long on outside (around column) and extending about half way through the metal On the opposite side the defective portion was 4 inches wide on inside, and extended for one third to two-thirds the way through the metal. There were indications of shear at about 45°, similar to cases previously noted, at the bottom, where the column broke into

TABLE I.

RESULTS OF BREAKING TESTS OF CAST-IRON COLUMNS.

Column No.	Length.	Outside diameter.	Thickness — Maximum.	Thickness — Least.	Thickness — Average.	Location of break.	Breaking load, lbs.	Compression.	Character of metal at fracture.	Sectional area.	Breaking load per sq. in. of area. lbs.
I.	190¼ ins.	15 ins.	1	1	1	About 3 ft. 4 ins. from bottom.	1,356,000	.....	Medium grain; *a* blowholes and dirt.	43.98	30,830
II.	190¼ ins.	15 ins.	1 5-16	1	1⅛	Bet. 1 and 5 ins. from bottom.	1,330,000	.....	Medium grain: *b* fairly uniform, spots of dry dirt.	48.03	27,700
B 2.	190¼ ins.	15 ins.	1¼	1	1⅛	Bet. 3¾ feet from bottom and 6½ ft. from top.	1,198,000	2½ ins. bet. 150,000 and 1 108,000.	Coarse, but uni- *c* form; a few flaws.	48.03	24,900
B 4.	190¼ ins.	15⅛ ins.	1 7-32	1	1⅛	Betweeen bottom and one-third up from bottom.	1,246,000	2¼ ins, bet. 150,000 and 1,246,000.	Coarse in centre; *d* finer on outside; cinders and slag.	49.48	25,200
5.	190¼ ins.	15 ins.	1 11-16	1	1 11-64	At bottom flange.	1,632,000	2 5-16 ins. in 8 ft. 3 ins.	Fine grain and *e* uniform where no flaws occur'd.	50.84	32,100
6.	190¼ ins.	15 ins.	1¼	1⅛	1 3-16	No break; permanent set of 1 3-16 ins. in 8 feet.	Over 2,082,000	⅜-in. betw'n 232,000 and 1,108,000	No break. *f*	51.52	Over 40,400
XVI.	160 ins.	Bet. 8¼ and 7¾ ins.	1¼	⅝	1	Where chaplet was placed at middle and at ends.	651,000	.....	Metal g'd; me-*g* dium grain.	21.99	31,900
XVII.	160 ins.	8 ins.	1 3-32	1	1 3-64	At middle and ends.	612,800	.....	Fine grain, uni-*h* form, and free from flaws.	22.87	26,800
7.	120 ins.	6 1-16 ins.	1 5-32	1⅛	1 9-64	At middle and each end.	400,000	.....	Good even grain, *i* no flaws.	17.64	22,700
8.	120 ins.	6 3-32 ins.	1⅛	1 1-16	1 7-64	At middle and each end.	455,200	.....	Fine grain, uni-*j* form, and free from flaws.	17.37	26,300

REMARKS.—*a*. One place, foundry dirt extended half way through; another place, foundry dirt and honeycomb between inner and outer surface.

b. At a pressure of 1,302,000 a slip of some kind occurred, which dropped the pressure to 1,275,000; again run up until break occurred. Upper portion sprung ½-inch in 9 feet 4 inches.

c. At 1,108,000 column sprung badly; movement recorded under compression.

d. Bad spots, cinder pockets and blowholes near middle of column; small cracks in necking near top; column given a permanent set.

e. Flaws and foundry dirt at point of break; load was carried as high as 1,803,000. The dummy head against which column rested was found broken after the test; this may have had something to to do with character of break.

f. Pressure run up to 1,108,000 and released. It was again run up to 2,082,000, released and run up to 2,033,000. Column could not be broken; capacity machine reached.

g. At time of breaking, column had a vertical deflection of 3 9-16 inches and a horizontal deflection of 1⅛ inches; fracture seemed due to flexure.

h. Vertical deflection, 4¼ inches; horizontal, 7-32 inches.

i. Vertical deflection, 3¼ inches; horizontal deflection, 1 11-32 inches.

j. Vertical deflection, 3 inches; horizontal deflection, ⅞ inch.

small pieces, The total number of pieces was 15. The fractured surface revealed many cinder pocket and blowholes near middle of column. Small cracks were observed in the necking near top of column.

Column 5.—Column broke into 14 pieces; all fractures occurred below the lower necking on column and broke through bottom flange. The permanent set in the shaft between the upper and lower necking was $2\frac{5}{16}$ ins. in 8 ft. 3 ins.; the upper part of the shaft above the necking remained perfectly straight after the test. Flaws were found in fractured surfaces near bottom, of foundry dirt. One bad flaw about 5 ins. wide and 4 ins. high (long) on outside, extending three-fifths of the way through. Quality of metal was rather fine grain and very uniform where no flaws occurred. Part of the shaft remained intact to end, and part of flange was left on. After the test, it was found that a dummy head against which the end of the column bore, was broken in such a way that the load on the column was eccentric after the head gave out; the nature of the fracture sustains this belief.

Column 6.—The test was discontinued when a load of 2,033,000 lbs. had been reached, the capacity of the machine having been reached. The permanent set of the column after it was removed from the testing machine was $\frac{3}{16}$-in. in a length of 8 feet 5 ins. The concave side, after the test, was about 90° from the joints of the flack, and undoubtedly was the top of the column as cast in the mold.

Column XVI.—One fracture occurred at a point where the chaplet for holding down the core was imbedded into the metal of the column. the metal outside of the chaplet was $\frac{7}{8}$-inch thick, and the chaplet 3-16-inch metal. The cast metal did not adhere to the chaplet. The column broke into six pieces (at middle and at each end). The fracture at the middle was nearly square off, and very near the exact middle point between the two ends. The fractures were about one foot from each end and irregular in outline. The metal was good, of medium grain. Wires were attached to the shaft of the column, 6 feet 6 inches from bottom, and ran perpendicular to the axis of the column, one horizontally and one vertically. These were carried to the outside of the building in which the tests were being made, and the actual vertical and horizontal deflections of the column were observed in conjunction with the corresponding loads. There was no evidence of shear at the fractured surfaces, as in the case of the larger columns. Failure seemed to result primarily from flexure.

Column XVII.—The column broke into eight pieces, the fractured points being at the middle and near each end. Quality of metal at fractured surfaces was fine grain, uniform and free from flaws.

Column 7 was broken into four pieces, the fractures being 3 inches to one side of the middle of the column and near each end. The quality of the metal was good, even medium grain, with no flaws.

Column 8.—The quality of metal was fine grain, uniform and free from flaws. The column broke into four pieces, fractures being at middle and near ends; broke off nearly square at each point; no signs of shear in metal.

Two of the 15-inch columns tested, Nos. B 2 and B 4, were taken from the Ireland Building, which it will be remembered, collapsed August 8th, 1895. The four remaining 15-inch columns were made from drawings prepared by the Department of buildings of New York city, and were as nearly as possible duplicates of the Ireland columns.

The columns marked I. and II. were made by the Jackson Iron Works, New York city, of their ordinary run of metal. They were cast while other columns were being cast, with no knowledge of their ultimate use. The two marked 5 and 6 were made by the Healy Iron Works, Brooklyn, N.Y., who were informed of what the columns were wanted for. The drawings for the 6-inch and 8-inch columns were also made by the department.

All the columns broken were, we understand, fair samples of the ast-iron column used in buildings in New York city, and regularly passed by the Building Department as coming within the provisions of the law.

The building law of the city of New York says:

"The strength of all columns and posts shall be computed according to Gordon's formulæ, and the crushing weights in pounds, to the square inch of section, for following materials, shall be taken as the co-efficient in said formulæ, namely: Cast-iron, 80,000. . . . The factors of safety shall be as one to four for all posts, columns and other vertical supports when of wrought-iron or rolled steel, and as one to five for other materials, subject to a compressive strain."

Applying Gordon's formula* with the co-efficient 80,000, as above required, in the numerator, and 400 (which is not given in the law, but is given in Haswell's Pocket Book, to which reference is made) in the denominator, we have

$$S = A \frac{80{,}000}{1 + \frac{l^2}{400\, d^2}}$$

* Mechanics' and Engineers' Pocket Book, Chas. H. Haswell, 1897, p. 768.

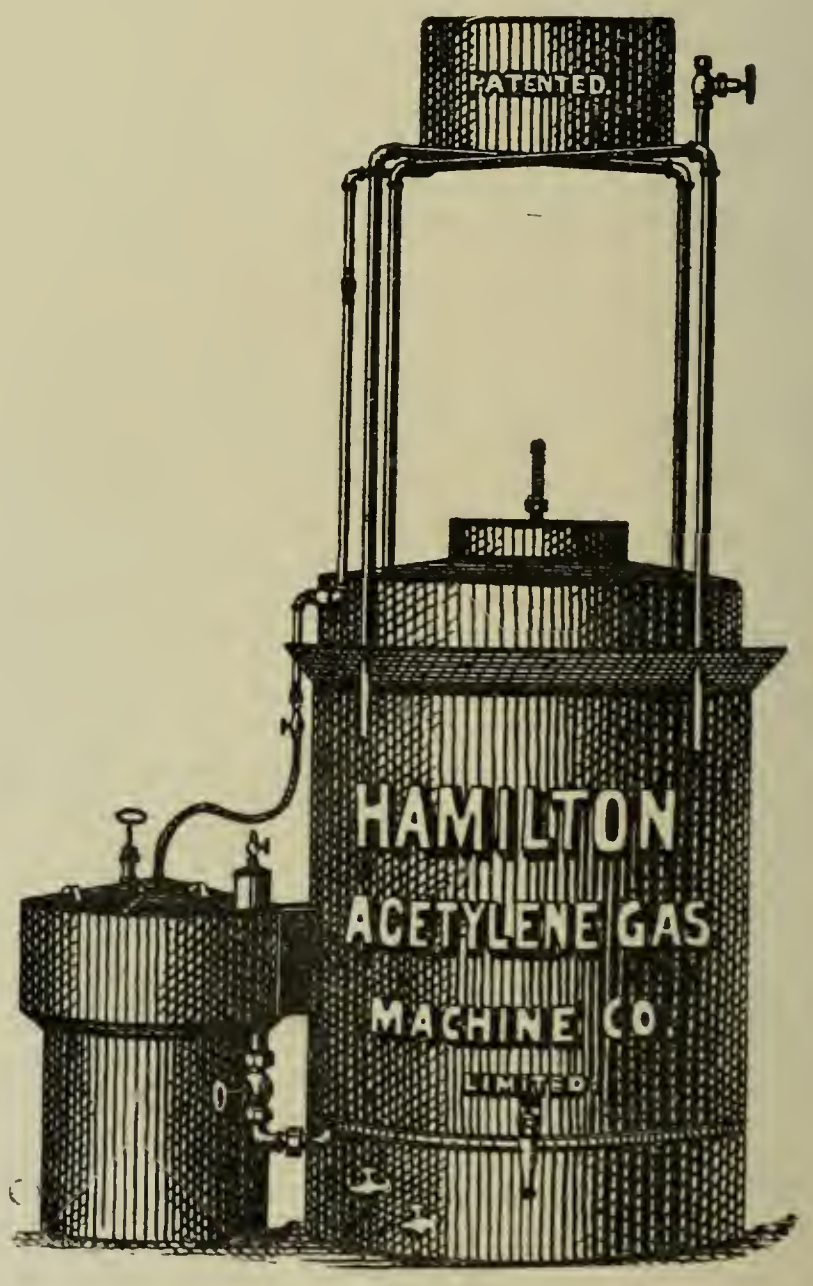
in which S is the breaking load, A = sectional area in sq. ins., l = length, and d = diameter of the column in inches.

For the 15-in. columns we have l = 190 ins., d = 15 ins., S = 57,143 A. For the 8-in. columns, l = 160 ins., d = 8 ins., S = 40,000 A. For the 6 in. columns, l = 120 ins., d = 6 ins., S = 40,000 A. That is, by the New York law, the 15-in. columns would be calculated to have a breaking strength of 57,143 lbs. per sq. in., while the actual tests show that their strength was only from 24,900 lbs. to something over 40,400 lbs. per sq. in. The 6 and 8-in. columns would be calculated to have a breaking strength of 40,000 lbs. per sq. in., while their actual breaking strength was only from 22,700 to 31,900 lbs. If such columns as these are loaded in buildings with the loads which the law allows, the factor of safety, instead of being 5, as required in the law, is actually in some cases more than 2. This is also borne out by the results obtained during similar tests conducted about a year ago by the Department of Buildings with full-sized cast-iron columns. The dimensions and results of these tests are given in Table IV. The values given in the column headed "Breaking load" are in round numbers, hence the breaking loads per square inch of area are correct to the hundreds as given.

A NEW ACETYLENE GAS GENERATOR.

The Hamilton Acetylene Gas Machine Co. having acquired the rights of a new acetylene gas generator invented in Welland, has established a factory at 228 King Street East, Hamilton, where it is now turning out large numbers of the machines, for which there is an active and growing demand.

A rough sketch of this machine is presented herewith. The water for feeding the carbide is taken into a tank above the gas holder, and this tank is kept full by means of a ball-cock attachment such as is used in a water closet tank. From here the water is fed to the car-



bide chamber shown to the left of the foot of the gas-holder. The holder is much the same in principle as a coal gas holder, and has the usual water-seal. As the gas is exhausted from the holder, a small bar which projects over the edge of the roof of the holder, catches the arm of a lever valve, and as it descends the valve is opened and the water starts to flow from the upper tank through a rubber pipe into the carbide chamber. The jet of water does not fall in one spot on the carbide, but is distributed over the material in a spray on all sides from a nozzle. When gas is thus generated by the water, the acetylene fills the holder, but when full the excess of pressure is relieved either by the top of the holder striking a spring valve and so

opening an outlet to the waste gas pipe which leads outside the building; or by an internal pipe, the lower end of which is lifted above the water-seal before the holder is full to excess. Two small cocks at the bottom of the holder let off the water that may gather from condensation; and when the carbide chamber needs re-charging a cock is turned in the gas supply pipe to prevent the gas from returning out of the holder. The carbide is held in the chamber by a wire cage in which receptacle it may be agitated by a shaker which can be operated by an outside handle.

The following are the special claims put forth for this machine by its manufacturers: (1) It is perfectly automatic in its action, and makes gas equal to the consumption only. This they claim above all other machines that are in the market. (2) It is not dependent upon the gas pressure to regulate the supply of water to the carbide, consequently the pressure upon all parts of the machine is at all times equal and does not exceed the amount necessary to supply the burners, viz, one and one-quarter ounces per square inch; it is therefore absolutely safe. (3) It mechanically regulates the quantity of water that is from time to time automatically brought in contact with the carbide, as the consumption requires, so that gas cannot be generated beyond the capacity of the machine. (4) The generator is so constructed that the carbide can be added and the ashes instantly removed without loss of gas, without shovelling any ashes, and without unscrewing any parts of the generator with a wrench or otherwise. All we have to do is to lift the cover off the generator and lift out the vessel and dump contents, then re-charge with carbide. Joints are all water joints. We challenge any other machine on these points. (5) A generator holding from 30 to 50 pounds of carbide will supply gas for a large dwelling house or store sufficient to last two or three weeks, and will require little, if any, attention.

The company is in possession of a number of very gratifying testimonials from users of the machines, and claims to have the cheapest machine in the market.

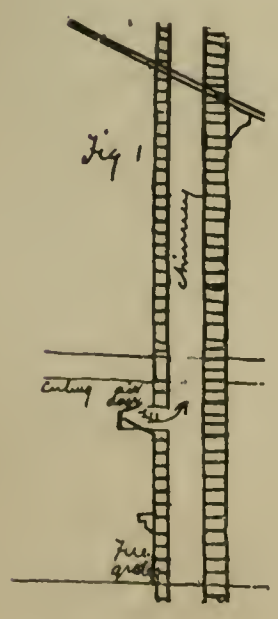
The president of the company is Dr. George S. Bingham, and the secretary, A. J. Seguin.

For The Canadian Engineer.

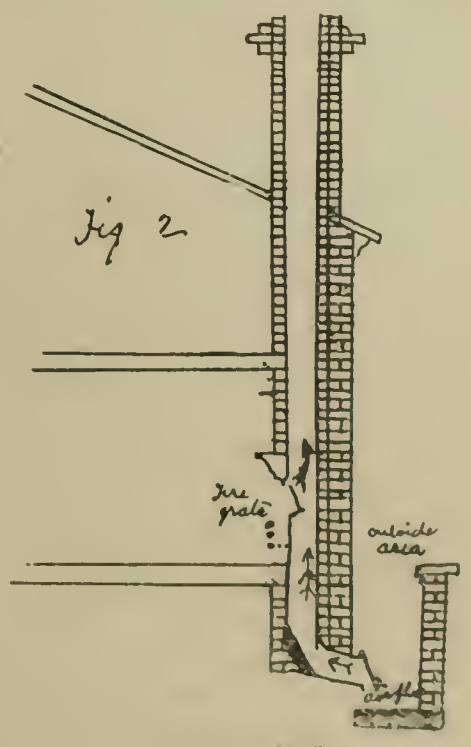
DOWN DRAUGHT IN DOMESTIC CHIMNEYS.

BY W. M. WATSON, TORONTO.

In answer to your query—what will prevent cold air passing down the chimney into your parlor, through the open fire-grate? I may first state the reasons for air doing so, are, because the room is of higher temperature than the outside atmosphere, or even the air contained in the chimney shaft, and the brick work forming the inner

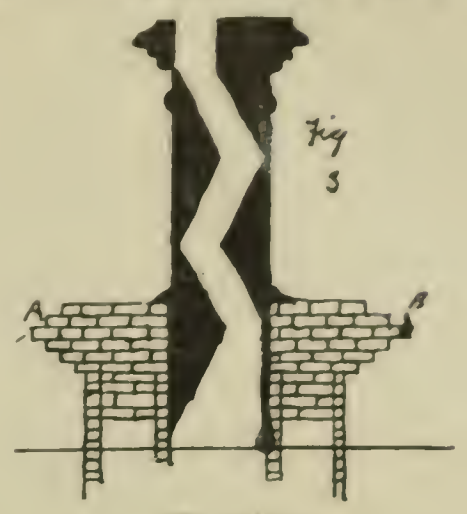


DOWN DRAUGHT.



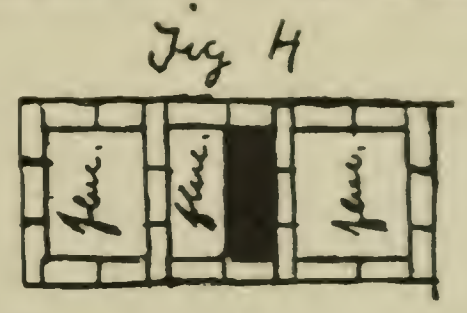
DOWN DRAUGHT.

wall of the shaft. Second, because probably your chimney is built straight and vertical from your grate to the head of the flue, without having any proper bend or goose neck offset, to prevent weight of the heavy, cold, outside air from passing down the full length of the chimney; thus providing an easy route for the outside atmosphere to secure heat by entering and mixing with the air of the parlor. You might possibly prevent it by ventilating your room near the ceiling, through and into the offending flue. This would cool your room, but supply warmth to the inner brickwork of the flue and its contents of air. Your opening, if you adopt that plan, should have the mouth or opening looking up towards the ceiling. If your flue extends down to the basement or cellar where the air is near the same temperature as the air above the roof, then you can stop the nuisance by making an opening that will circulate the air from the cold basement to the housetop by way of the chimney flue causing always an upward current through the shaft. By fitting proper doors, when a fire is needed in



DOWN DRAUGHT.

the parlor, the door at end of flue in basement or outside can be closed, and the one behind the fire grate opened and again reversed when no fire is needed, see figure 2 or third, it might be remedied by making



DOWN DRAUGHT.

a chimney top of galvanized sheet iron similar to sketch 3 and 4 with a bent flue, to take the weight and pressure of the heavy outside air, and act in place of the goose-neck or offset, that should always be constructed near the head of every chimney-flue serving a dwelling-house.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Canadian Society of Civil Engineers was held in Montreal, January 11th. The first business was the election of scrutineers. J. W. Heckman, T. W. Lesage and James Ewing were elected scrutineers of the ballot for the election of officers and members of council; H. B. Stuart and W. G. Matheson, of the ballot for the nominating committee; F. L. Somerville, J. S. Vinden and L. G. Papineau, of the ballot for amendment and by-laws, proposed by members, and J. W. McCarthy, L. J. Maven, and L. A. Amos, for the ballot for amendment to by-laws proposed by the council.

The meeting was then adjourned in order that the members might avail themselves of the invitation of the Royal Electric Co. and the Chambly Power Co., to visit the works, now nearly complete, at Chambly, Que. The Grand Trunk and Vermont Central railways provided a special train, and upwards of 130 members of the society took part in the excursion. On their arrival they were received by S. T. Willet, president of the Chambly Co., and Senator Thibaudeau, president, and W. H. Browne, general manager, of the Royal Electric Co. It is unnecessary to add anything to the illustrated description of this plant in our December number, except that the visiting engineers expressed their high approval of the work, and their sense of its commercial importance. After the inspection luncheon was served in the switchboard chamber, where speeches were made by the Mayor of Chambly, S. T. Willet, G. H. Duggan, Senator Thibaudeau, W. H. Browne, P. St. George, J. A. L. Strathy, and W. McLea Walbank. While at Chambly some of the visitors took the opportunity to visit the old fort built by Mons. de Chambly, in 1711. On the return journey to Montreal, the train was stopped at the Victoria Bridge, so that the members might have an opportunity of inspecting the superstructure in process of erection there. In the evening, the annual banquet was held at Windsor Hotel and was largely attended. C. E. W. Dodwell, of Halifax, acted as toast master, and his genial originality and ready wit contributed much towards making the dinner, what it certainly was, the most successful and enjoyable one ever held. The adjourned meeting was resumed at about 10.30 a.m., on Wednesday. In the

absence of T. C. Keefer, C.M.G., President, and Messrs. Jennings and Thompson, vice-presidents, G. H. Duggan occupied the chair. The secretary, Prof. C. H. McLeod, read the report of the Council for 1897, which was as follows :

ROLL OF THE SOCIETY.

The elections comprised eight members, fourteen associate members, one associate, and fourteen students. Ten associate members have been transferred to the class of members, and four students to the class of associate member. Resignations have been received from two members, one associate and one student. The deaths have been:

Members—Alan MacDougall, H. F. Perley and D. A. Stewart.

Associate members—James R. Peddar and H. L. Langevin.

Associate—John H. R. Molson.

At present the membership stands as follows:

	Non Res.	Res.	Total.
Honorary members	6	2	8
Members	231	53	284
Associate members	115	30	145
Associates	28	13	41
Students	99	35	134
Total			628

At the same date last year:

	Non Res.	Res.	Total.
Honorary members	6	2	8
Members	218	53	271
Associate members	115	30	145
Associates	27	15	42
Students	94	31	125
Total			591

It will be seen that the number of members, associate members and students, i.e., the active membership of the society, has increased during the year. The total increase in the membership of all classes is thirty-seven. At the time of the last annual general meeting there were eight new applications, and at the present time there are nine applications for admission into the society.

The eleventh annual meeting was called to order at 10 o'clock a.m. Tuesday, Jan. 12th, 1897, Herbert Wallis, president, in the chair. Fifteen ordinary meetings were held during the year, at which the following papers were read : A New and Cheap Method of Dressing Car Wheels, by R. Atkinson, M. Can.Soc. C.E.; Fraser Valley Reclamation, by R. E. Palmer, Assoc. M. Can. Soc. C.E.; The Old Albion Mines Railway, by the late D. A. Stewart, M. Can. Soc. C.E.; The Separate System of Sewerage in Ontario, by Willis Chipman, M. Can. Soc. C.E.; Fortifications, by C. R. F. Coutlee, Assoc.-M. Soc. C.E.; Results of Experiments on the Strength of White Pine, Red Pine, Hemlock and Spruce, by Prof. H. T. Bovey, LL.D., M. Can. Soc. C.E.; Sewage by Subsoil Irrigation, by E. Mohun, M. Can. Soc. C.E.; Impulse Water Wheels, by J. T. Farmer, student Can. Soc. C.E. Abstracts have also been read on the following subjects: 1. Water Power, its Generation and Transmission; 2. Water Power of Caratunk Falls; 3. The Transverse Strength of Beams; 4. The Underpinning of Heavy Buildings; 5. Methods and Results of Stadia Surveying; 6. The Liverpool Water Works; 7. Relative Tests of Cast Iron and Strength of Cast Iron; 8. The New Water Scoop of the Pennsylvania Railway; 9. Water Power and Compressed Air Transmission Plant for the North Star Mining Co.; 10. Foundations of Tall Buildings; 11. Solar Work in Surveying; 12. Through Barren Lands; 13. Comparative Tests of Steam Boilers with Different Kinds of Coal; 14. Paint as a Protection for Iron; 15. Inclined-Plane Railways; 16. 100 Feet Standard of Length of Boston Water Works; 17. The Manufacture and use of Sand Cement; 18. Some Experiments on the Condensation of Steam; 19. An Electrical Method of Measuring the Temperature of a Metal Surface on which Steam is Condensing. A series of lectures on the "Transmission of Power by Compressed Air, Gas and Steam," by Prof. J. T. Nicolson, B.Sc., M. Can. Soc. C.E., and Prof. R. J. Durley, B.Sc., Assoc.M.Can.Soc.C.E., were delivered during February and March of this year. The lectures were illustrated by lantern projection, and attracted very large audiences. They are now published in condensed form in Vol. XI., Part I., and constitute a valuable contribution to the published transactions of the society. An illustrated lecture on "Cantilever Bridges," by Mr. J. A. L. Waddell, Ma. E., bridge engineer, of Kansas City, Mo., was delivered at the meeting of October 28th.

The accommodation of the society has been enlarged during the year. The council at its first meeting appointed a committee on Dominion Legislation, but the committee has not deemed the time opportune to take any action. The several provincial committees on legislation, as constituted last year, were re-appointed. During the year additions have been made to these committees owing to the death of two of the members and the resignation of others. The committees are now constituted as follows: Nova Scotia—M. Murphy, C. E. W. Dodwell, W. R. Butler, W. G. Matheson and H. S. Poole. New Brunswick—P. S. Archibald and Hurd Peters. Quebec—St. George Boswell, L. A. Vallee and E. Marceau. Ontario—W. T. Jennings, M. J. Butler, Willis Chipman and W. G. Thompson. Manitoba—H. N. Ruttan, G. H. Webster and J. Woodman. N.-W. Provinces—W. D. Barclay, G. A. Stewart and W. I. Thompson. British Columbia—G. A. Keefer, H. J. Cambie, A. J. Hill, H. Abbott and F. C. Gamble.

In October the council appointed H. Wallis, W. J. Sproule and C. H. McLeod, a special Central Committee on Legislation with power to add to its number H. Irwin has been added to the committee. Since its appointment this committee has, in conference with the Quebec Provincial Committee, given a large amount of time to the promotion of legislation in Quebec. In Nova Scotia the Provincial Act was, in January last, passed through the Lower House, but consideration of it was deferred in the Legislative Council, and it will be necessary to reintroduce the bill during the session which will open some time in January.

At the first meeting of Council W. J. Sproule resigned, and his place was filled by the appointment of E. Marceau. On June 8th C. H. Rust was appointed a member of council to fill the place made vacant by the death of Alan MacDougall. On October 12th G. H. Duggan was appointed a vice-president in the place of Prof. H. T. Bovey, resigned, and W. J. Sproule was elected to the council to replace G. H. Duggan.

Signed. T. C. KEEFER, President.
C. H. MCLEOD, Sec'y.

This, together with the treasurer's report, and that of the Library Committee, was adopted. Some discussion on the arrears in subscriptions followed the treasurer's report, motions were made and withdrawn, and finally the council was left to use its own discretion in individual cases as formerly. K. W. Blackwell, the treasurer, referring to the legacy of $500 left by the late H. G. C. Ketchum, said that the council felt it had no power to dispose of it, and thought that the meeting might specify the purpose to which it was to be devoted. Herbert Wallis, in reporting progress on behalf of the Committee on Legislation, said that after a great expenditure of time and energy in Quebec, the Close Corporation bill had passed and, notwithstanding some alterations, the bill was now substantially in the form they had labored for all along. This scheme is not a selfish thing. It will benefit those who come after us, said Mr. Wallis, by materially raising the status of civil engineers. Our secretary (Prof. C. H. McLeod), has labored splendidly, and our connection with McGill University has been of undoubted value. Nor must we forget the great credit due to Messrs. Marceau, Boswell, Vallee, Irwin and Sproule. The bill awaits only the sanction of the Lieutenant-Governor to become law. He heartily congratulated the society. Some desultory remarks followed on the subject of the bill, and the secretary announced that some copies of it had been printed, and could be seen at any time by members of the society. The chairman, G. H. Duggan, said he thought the incoming council would like some instructions how to proceed in other matters connected with legislation.

The chairman then called on Prof. Butler for his report on standard measures. The secretary then asked simply that the powers of this committee be continued. The report of the Committee on the Gzowski Medal was received. It recommended that the medal be awarded to Prof. S. L. Fortier, B.Sc., Montreal, for his paper on "The Storage of Water in Earthen Reservoirs."

W. J. Sproule then proposed the following resolution : "That it is in the interests of the engineering profession that the method of doing professional work, for giving advice, for a remuneration estimated by a percentage of the cost of the work to be constructed, is not in the best interests of the profession, nor for the clients of engineers; that its tendency is

immoral, and that this method should be discontinued as soon as possible; and that the attention of all the members be directed in a special manner to this resolution." He said: This is a big question, I know, but not new to many engineers. I believe that the practice is wrong in every respect. That the engineer should be influenced by the idea that the more he makes the work cost, the more comes into his pocket, is only human after all. I do not pretend by any means that all are influenced by mercenary motives, but since the way is open, it is not surprising that weak individuals sometimes fall into such a natural trap. In the case of many small muncipalities where possibly some member cannot even read or write (and there are such), what would be the effect of such a known fact on a designing engineer? This motion was opposed in a fluent and vigorous speech by J. M. McCarthy, who said that such enormities as Mr. Sproule wished to render impossible were no more common in the civil engineering profession than in any other, and might be left to work their own punishment from the popular judgment. He gave some pertinent reasons why the present method should continue to govern professional services. The motion, which was seconded by F. F. Miller, was lost on division.

The scrutineers of the ballot for amendments to by-laws announced the result of the ballot for the amendments proposed by the council. Article 28 was the first attacked. It is as follows: There shall be a council, consisting of the president, vice-president, treasurer, secretary, honorary councillors and councillors, and of this council five shall constitute a quorum. The members of council shall retain their position until their successors have been appointed. It was proposed to leave out the word "secretary" in the second line, and to add to the article "the secretary to be appointed by the council." Lost. Article 35 was the second. It provides that the nominating committee shall draw up a list of voting members qualified to fill the various offices, specifying that of secretary amongst the others, the entire list to consist of 34 names. It was proposed to leave out the word "secretary" and exclude that position from the list of councillors. Lost. Article 19 was the third. This provides that each student shall pay $2 per annum. It was proposed to amend this so that each non-resident student should pay $2 and each resident student $3 per annum. Lost. The fourth proposal was for a new by-law, as follows: Every new member as associate member shall upon admission to the society, pay a fee of $20, but no additional payment other than the increased annual subscription shall be due from an associate member upon his transfer to membership, which was adopted.

The amendments proposed by the members were all carried. The first referred to by-law No. 27, which is: -The officers of the society shall consist of a president, three vice-presidents, a treasurer, a secretary, a librarian; the past presidents, who shall be styled honorary councillors; and fifteen councillors. Of the fifteen councillors, not more than three may be associate members. The words "last three surviving" are to be inserted before the words "past presidents," and the words "who continue to be members," inserted immediately after the words "past presidents." Article 34 provides for the appointment by the council of committees of five each on finance and the library, without regard to the number which shall form a quorum on each committee. The amendment is that three shall form a quorum. By-law No. 35 is amended to agree with the amendments to No. 27, and will be as follows:

"A nominating committee of eight voting members elected annually and of the last three surviving presidents, who continue to be members, shall draw up a list of names of such voting members as in its opinion are qualified to fill the offices of president, vice-presidents, treasurer, secretary, librarian, and councillors for the ensuing year, and who shall previously to their names being entered upon the list, have signified to the committee in writing their willingness to accept their several nominations."

H. Irwin said that from time to time outside members had complained that they were not represented on the council. This ought to be remedied. Members all over the country should send in a list of those whom they thought ought to be on the committee It is very difficult for the local committee to choose. H. Peters thought that there might be some difficulty about this. Still, while all acknowledge the rights of Montreal, other societies move their annual meetings from place to place. Would it not be desirable for the civil engineers? It would undoubtedly extend their influence. He gave notice that at the next annual meeting he would move that the annual meetings be held in different places. W. J. Sproule thought that this object would be sufficiently met by a summer convention, one of which had been held. An important consideration is that all the records of the society are in Montreal.

The scrutineers then announced the result of the ballot for the election of officers, which resulted as follows: President, W. G. McN. Thompson, of St. Catharines; Vice-Presidents, K. W. Blackwell, P. W. St. George, H. D. Lumsden; Secretary, Prof. C. H. McLeod; Treasurer, H. Irwin.

Members of Council—H. N. Ruttan, Duncan McPherson, C. E. W. Dodwell, G. H. Duggan, E. H. Keating, St. George Boswell, J. H. Shanley, C. B. Smith, J. D. Barnett, F. C. Gamble, J. Galbraith, Hurd Peters, W. McLea Walbank, J. L. N. Coste.

P. W. St. George expressed the thanks of Mr. Thompson, who was unavoidably absent, and also his own for election to their respective honors. The secretary then announced that the retiring president, T. C. Keefer, C.M.C., had sent an address on "The Progress of Engineering Works during the last ten years, and of Water Works in particular." This was read by C. S. W. Dodwell, and will be found reported upon another page.

In proposing a vote of thanks, Jno Kennedy said: "I have much pleasure in proposing a vote of thanks to our president, Mr. Keefer, whose absence we all regret very much. We owe him a great deal. The society honored itself as well as Mr. Keefer in electing him as president for the second time, and much of the success of the society to-day is due to his kind interest in it during the past ten years. Mr. Keefer has been honored by our Queen and by his profession, and I am sure I am speaking for every individual member, not only of the society, but of the profession at large, when I say that all the honor and more is due to him. I say again, therefore, that it gives me great pleasure to propose a vote of thanks to Mr. Keefer for his very interesting address just read, and for his services as president of our society. This was seconded by H. Peters and carried by a standing vote. The meeting terminated with votes of thanks to the Royal Electric Co. at Chambly, the G.T. and C.V. railways, the scrutineers, the Hon. Messrs. Attwater, Duffy, and the other gentlemen who assisted in passing the Close Corporation bill at Quebec, to Prof. C. H. McLeod for his valuable services in the same direction, to the treasurer, K. W. Blackwell, to the St. Lawrence Cement Co., and to the curator of the fort at Chambly.

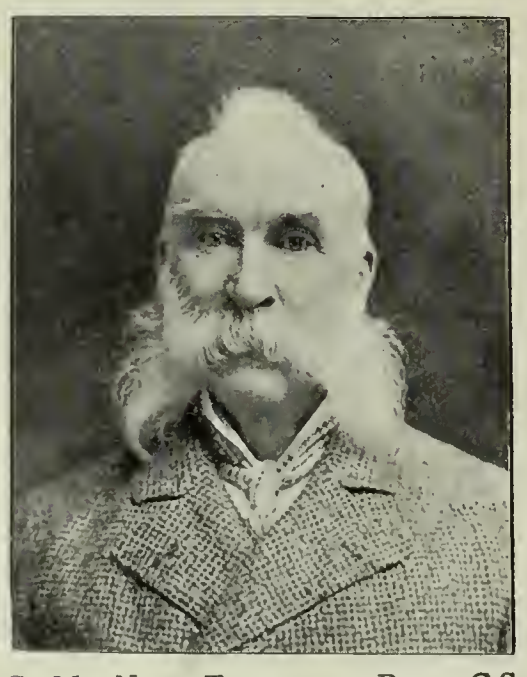
At the regular meeting, held January 20th, P. W. St. George, vice-president in the chair, the secretary announced applications for admission from Chas. Biggar, of Ottawa; H. F. Duck, Toronto; J. W. Fraser, Ottawa; Lewis Skaife, Montreal: for transfer from W. P. Morrison, Halifax; C. C. Wonsfold, New Westminster; students, G. A. Beauchand, E. Lorne-Bond, H. D. Pariseau, L. F. Gagon, H. L. St. George, F. T. St. George, all of Montreal.

A letter was read from Herbert Wallis, announcing the gift of a fire basket and fender for the accommodation of members in the new smoking-room, which, together with a reading-room, has recently been added. It was suggested that something should be done to celebrate the opening of these rooms. Prof. Nicholson suggested an exhibition of slides, illustrating great engineering works. Other members wished this to be followed by something free and easy for once, and in consequence a committee, composed of Profs. McLeod, Nicholson, and Durley, and Messrs. McCarthy and Loveless, was appointed to make the necessary arrangements for a smoking concert.

Prof. Nicholson then read the abstracts of two papers on "Some Experiments on the Condensation of Steam," and "An Electrical Method of Measuring the Temperature of a Metal Surface on which Steam is Condensing." The former by Profs. Callendar and Nicholson, and the latter by Prof. Callendar alone. Prof. Durley said that these papers were likely to impress any hearer of them with the great care and skill displayed by the experimenters, but he thought that the results would hardly appeal at first sight to the practical man. He would ask under what circumstances is the rate of condensation less than that given, and what would be the probable effect if the steam had been allowed to pass through as a current of considerable speeds. To which Prof. Nicholson replied that he could not say off-hand what was the velocity of the steam. The speed was considerably varied, and he could not say that

he found the rate of condensation attributable in any way to the rate of velocity.

J. Farmer, Ma.E., was then called upon for his paper on "Impulse Water Wheels." H. Irwin said he had not much to do with this class of work, but that it was fast coming to the fore, especially in mining districts. Prof. Durley had hinted that Prof. Nicholson had not shown the immediate practical advantage of his experiments. He (H. Irwin) greatly objected to the careless use of the word "practical." Very many men who claim to be considered practical are not practical at all. The theorist may be in advance of the customs of the day, but often the more practical for that very reason. Water wheels had been in use in older countries by "practical men," for a hundred years, and during all this time they had been losing half their power. The advance made in recent years was due largely to such comparatively isolated investigations. Prof. Durley quite agreed with H. Irwin, and meant not that Prof. Nicholson's investigations were without practical value, but it would have been interesting if Prof. Nicholson had shown their direct effect upon the practical use of water wheels. Mr. Farmer says that the higher the speed of the wheel the greater the arc of action. Has the high-speed wheel a greater arc than the low-speed one? Mr. Farmer replied that the arc of action was intended to refer to the time during which the water really acted on the bucket. Prof. Nicholson expressed his appreciation of the value of the paper. He had seen much written upon this subject, but the paper under discussion was the first to give accurate information. On the subject of the arc of action: did Mr. Farmer say whether a number of jets —say three or four—were ever used on the same wheel at different angles to get rid of the friction of the bearings? Mr. Farmer: "Yes. It is given in the Pelton catalogue." Prof. Nicholson: "Could not the defect of these wheels be got over by—say 15 jets?" Mr. Farmer: "It has its limits. He doubted whether more than five or six could be put in advantageously." Prof. Nicholson: "It would be interesting to make experiments with the throttling gate close to the jet." He again thanked Mr. Farmer. Prof. Durley proposed a vote of thanks to the writer of the paper. Mr. Farmer expressed his thanks, and wished that the experiments had been more complete, and the results more definite.



W. G. MacNeil Thompson, Pres. C.S.C.E.

W. G. MacNeil Thompson, who has just been elected president of the Canadian Society of Civil Engineers, is one of the best-known of Canadian engineers. He was from 1852 to 1856 engaged on surveys and construction of Grand Trunk Railway, Canada, from Toronto westward; from 1856 to 1859 he was resident engineer surveys and construction of Welland Railway. From 1859 to 1860, contractors' engineer and agent on River du Loup section Grand Trunk Railway, Canada; from 1860 to 1863, contractors' engineer and agent on reconstruction of Northern Railway of Canada; from 1863 to 1864, engineer and manager for Dyphusys Cassen Mining Co. of North Wales; from 1864 to 1868, engineer and agent for contractor of Ceylon Government railway from Colombo to Kandy; from 1868 to 1872, engineer on surveys and construction of Intercolonial Railway, Canada; from 1872, engineer in charge of survey of Lake St. Louie; from 1872 to 1889, resident engineer southern division Welland Canal enlargement to 14 feet; from 1889 to 1891, resident engineer Sault Ste. Marie Canal, Ontario; from 1891 to 1894, superintending engineer Sault Ste. Marie and Welland canals. At present Mr. Thompson is superintending engineer Welland canals. Mr. Thompson was elected M. Inst. C.E., 1877; M. Am. Soc. C.E., 1879; M. Can. Soc. C.E., 1891; Associate Am. Inst. E.E., 1887.

J. L. N. Coste, C.E.

Jean Louis Napoleon Coste, Chief Engineer of the Department of Public Works, who was elected member of council of the Society of Civil Engineers for the year 1898 at the annual meeting, held on the 12th of January, was born in Amherstburg, Ontario, on the 31st July, 1867. He is the eldest son of N. A. Coste, one of the collaborators of M. de Lesseps, in the construction of the Suez Canal, and of Mathilde Robidoux, a descendant of one of the men who came from Brittany with Jacques Cartier. Mr. Coste received his technical education in France, and was afterwards articled to the late Sir James Brunlees, past president of the Institution of Civil Engineers of England, with whom he remained several years on various maritime works, returning to Canada in 1883, when he was immediately employed on the staff of Mr. Smellie, then Chief Engineer of the Canadian Pacific Railway in Montreal. In November of that year Mr. Coste was appointed on the staff of the chief engineer of Public Works, and was placed in charge of works in Ontario, Quebec, and Manitoba. In July, 1892, Mr. Coste was appointed to his present position, that of Chief Engineer of Public Works, and as such has charge of the following works: (1) Construction of, and repairs to, wharves, piers and breakwaters built by the Federal Government in the Dominion of Canada. (2) The construction and repairs of all river works. (3) The dredging in harbors and navigable rivers. (4) The construction and administration of graving docks. (5) The construction, maintenance and administration of the slides and booms on the Ottawa, St. Maurice and Trent Rivers. (6) The construction and maintenance of inter-provincial bridges, and of all federal bridges in the North-West Territories. (7) The direction of all hydrographic surveys made by the department. (8) The preparation of all reports on the proposed construction by private enterprise of all works in or over navigable rivers.

WATER POWER IN CANADA.*

Having been honored by re-election to the presidency, after an interval of ten years, I desire to thank you most heartily for this renewal of your confidence, and at the same time to congratulate the society upon its record in this the first ten years of its existence, during which total membership and revenue have increased about fifty per cent. Unlike our predecessors in England and America, we, as the offspring of later times, have encountered no early period of suspended animation, but have advanced steadily, if not rapidly, in numerical strength, and maintained satisfactory financial stability. If we have not progressed proportionately in public usefulness or mutual enlightenment, it may be ascribed (in some measure at least) to the fact that some from whom much could be expected are too closely occupied with daily duties to contribute, as they might otherwise do, to our "transactions." Some may be too modest, and some too old, or possibly too indolent.

If, however, we have held our own as we have done in these recent years (which embrace several of world-wide depression), our prospects for the future seem brighter than when we began our organization in 1887. Then our great railway systems were practically completed; and, although this was the case with our enlarged canal systems only as regards the Welland, the work on the St. Lawrence was in an inert condition. Ample leisure was then afforded Canadian engineers for organization, amusement or foreign travel.

Now, however, there is a decided change in our position at home and abroad. Canada is now a colony of national importance, the largest independent member of a world-wide Empire, and none have contributed more to this advanced position than engineers of every class embraced in our society, which, while it excludes none, is composed almost entirely of the constructive rather than the destructive order.

In 1887 Canada was not a mining country; now, recent discoveries over a wide extent of our vast Dominion have brought the mining engineer to the front, and with him the hydraulic and electrical engineer, because water power is almost

* Being the president's address at the Annual Meeting of the Canadian Society of Civil Engineers, Jan. 12th, 1898.

universal in our mining regions from Labrador to Alaska. Our vast prairies, where is grown the most valuable quality of the most important cereal, have hitherto been unable to attract much foreign interest, though accessible to all nations; but the recent discovery of gold has been of such a character as to invite world-wide attention. Its influence (however temporary) cannot fail to produce increased agricultural development in our great North-west.

Since the birth of our society water power has attained a position of immense importance, owing to electrical transmission, which has given rise to new industries only possible where there is cheap and abundant water power, which also secures cheap intense electricity.

The rapid extension of the pulp industry in Canada is one of the results of cheap water power coupled with our abundant supply of raw material, easy reach of navigation, of rail, and the best markets; but the more recent electro-chemical industries are the exclusive products of cheap intense electricity. Here (as in mining) is a new field for the chemical, electrical, hydraulic and railway engineer. I include the chemist among the engineers, because I regard him as such, with the electrician, the hydraulic or mining engineer, producers though not creators of power, and, it may be, the chemical force is more potent than any other. If dynamite is a chemical compound the power-maker or discoverer is worthy to be numbered with the power user.

An electro-chemical industry of recent origin has been established in Canada by the discoverer, a Canadian chemical engineer, Thos. L. Willson. This is the manufacture of calcic carbide for the production of acetylene gas by means of electricity produced by the abundant water power of the Welland canal at Merritton, where the manufacture in commercial quantity was first started in 1896, and from whence the product has already been shipped to England, France, Germany, Italy, Australia and South Africa.

Another electro-chemical manufacture in which our profession is interested (on water power ground), which also depends on cheap electricity, is that of aluminum, for which the raw material is so widely distributed, but for which, as with the carbide, abundant and cheap water power is indispensable.

In view of its importance, owing to its wide distribution over Canadian territory, from the Atlantic seaboard to the Rocky Mountains, where no coal is found, and on account of its vastly enhanced value since the discovery of high voltage transmission, even where it is within the coal fields, I have chosen water power as the subject of some observations for the annual address.

I have heretofore drawn attention to this widely-distributed power outside of our coal regions, as to some extent a substitute for coal, upon the assumption of local application of power in both cases, whether water or steam, and then the vast difference presented itself that with the last the power could be taken to the work, while with the other the work must be taken to the power; for there was no thought then of electrical transmission. The utilization of water power would be very slight and very slow if under the old conditions of advance into the forest (as in the agricultural portions of the valley of the St. Lawrence), because our greatest extent of water power is in the mountainous and sometimes barren regions, not inviting to agriculture, though most favorable for the accumulation, maintenance and uniform distribution of water power throughout the year.

In considering the question of water power generally, and in comparison with steam, it may first be mentioned that while electrical transmission (where practicable) has enabled it to take the place of steam in many situations, the choice in others depends upon the work to be done, as well as upon the cost of fuel. For transmission purposes there are only the questions of the sufficiency and permanence of the power and its superior economy; but for lumber manufacture, although ample water power is at hand, and there is with it no question of ice difficulties, it is found in many cases that steam is preferable, because the mill site may be chosen in the best position for manufacture, shipment and storage of logs, and the waste material furnishes fuel for power. The cost and maintenance of a mill dam in many situations, with the necessary piers and booms for the logs, the damage and risk to mills, etc., during floods, are reasons urged (in addition to the questions of site and fuel) in favor of steam for this industry. But for other purposes the site of the water power (perhaps in a gorge) is unfavorable for many industries on account of difficulty of access and want of service ground; and here is the value of electric transmission of water power.

When adopting water power, one of the most important considerations is the possible need of future enlargement. Where all the water power of a stream of any point is secured by a dam, and this power can be drawn upon from time to time until the whole is applied, we have only to consider cost, and maintenance in the first place, even though the additional power must thereafter be obtained by coal, or transmission (when this last is commercially practicable), not only because the water power is sufficient for many years, but as far as it goes, it is more economical than any other. But if only part of the available water power is needed, and provision for the future must be postponed for financial reasons, then the question of how any future addition can be made without interruption becomes important in proportion to the purpose for which the power is required. If for water supply or electric light, either the original dimensions must be far beyond present wants, or there must be the power of duplication without interference with existing conditions, or else temporary power for this purpose on a sufficient scale, or permanent, if made auxiliary for future deficiency of water. Such considerations affect the question of the economy of water power for certain purposes and under certain conditions where a periodical increase of power must be provided for. It altogether depends upon local conditions whether an artificial water power, as it may be called, will be worth what it costs for any purpose; and more particularly if this is one in which power must be reserved for future needs. Temporary employment of surplus power could not be counted upon to build up permanent industries.

Electrical demand and transmission have created a "boom" in water power, under which in some cases the schemes proposed may become financial failures. There is evidently a limit to the distance to which water can be artificially conducted in order to reach a fall under the most favorable conditions of route. For power purposes the only useful portion of the aqueduct is that which lies below the surface level of water in it, and the value of this is in direct proportion to its size, and therefore, its cost, which includes the cost of all required work above this level. The longer the aqueduct the higher must be the fall which it secures, and the lower the fall the larger must be its dimensions and cost if it is to be efficient. Whether it will be profitable in either case depends upon the cost. Such natural dams of rock as those of Niagara, Sault Ste. Marie, Rat Portage, the Chaudiere, the Chats and others on the Ottawa are natural water powers of the first order; but the artificial powers created by our canals (apart from cost of every canal adjunct to the water channel) would never have been undertaken for water power purposes. There is a popular superstition that there is more in water than its weight, because that weight is felt "all over" as well as on the bottom, and a tendency to ascribe to it a fictitious value. This has possibly something to do with some projects.

In water power the discovery of lowest possible head level is of the first importance, and the one often of the greatest difficulty where this is not controlled by a dam, which (wherever practicable) is the only certain means of fixing it. When a dam does not exist, or is not obtainable, recourse is had to legend and the "oldest inhabitant," who has seldom proved old enough for the occasion. Our canal engineers have, with the best information, found their mitre sills in many cases very much higher than they intended them to be, because the river had gone very much lower than it had ever been said to have done. To secure at all times a required depth it seems necessary to add about three feet to the "oldest inhabitant." When, over fifty years ago, the Government first constructed timber slides on tributaries of the Ottawa, in the absence of any knowledge of the local range of water level, the mouths of these were found so high after the first flood that the timber could not be floated into them until a dam was built for this purpose.

The high-water level is more easily provided against, and is often more important in connection with the tail-race in fixing the wheel level, where the discharge is into a reach subject to great variation, like that below the Chaudiere Falls, where the extreme range between high and low water exceeds twenty-five feet; which, though of short duration, is about three times as great as the same range above these falls. Where the wheels

would be affected, as this is always the case at the season when the rise is greatest at the head, provision may be made to utilize this temporary increase of head level so as to maintain the necessary power during back water.

Where unceasing operation of power is required in our climate, duplication and separation of flumes (and it may be in some cases of tail-race) may, where practicable, warrant the additional cost in thus securing reserve power (as well as of machinery) when any particular channel has a surfeit of ice; as well as by so much contributing to a future enlargement.

Except upon our canals (where the least winter difficulties are experienced), our great water powers have been chiefly used as summer ones. in which the two independent questions connected with water power, viz.: the power of enlargement and extension without interruption, and the possible ice difficulties of a northern site, do not come in question. The large saw-mills have not worked in winter because their logs are frozen in. Before the railway reached them the mills stopped sawing when they could no longer ship their output; but, where they depend upon the water for their logs, whether they are worked by water or steam, they are idle in winter.

The coming of electricity, bringing with it the demand for winter power, has produced ice difficulties where they did not before exist, and were therefore not anticipated and not provided for, although winter water power, to a limited extent, had been in use. Increased power brought increased current, and this under certain conditions brought the submerged ice.

There is no question of more importance to our water powers than this one of uninterrupted operation in our northern districts where nearly all are located, and where (with perhaps the exception of the southern portion of our Pacific coast) ice in one form or another must be dealt with. It assails the moving water sometimes both from above and below, and, if undiscovered, chokes off the motive power.

In artificial channels the fixed surface ice above may diminish the water power by its increasing thickness and depression from superincumbent weight of snow saturated by winter rains and thaws, and, where these channels are fed from open water in which floating slush ice is moving, the latter may be drawn in to increase the throttling of the reduced water-way. The situation is greatly complicated by winter fluctuations of the open water from which the mill-race is fed, and in which the "slush" or "anchor ice" is running, a not uncommon situation in northern rivers which cannot be conveniently dammed or where sufficently large receiving basins cannot be created so that "slush" or "anchor ice" will not enter and travel through the mill pond to reach the flumes.

The ice question can be more fully appreciated by what has taken place in connection with water powers at Montreal and Ottawa. In the first case, the aqueduct of the Montreal water works, five miles in length, almost entirely in excavation, is fed from the St. Lawrence above the Lachine Rapids, where there is a smooth, swift current which prevents the freezing over in winter, but is often covered with "slush" or "anchor ice" when that is running. The Lachine Rapids below the intake of this aqueduct are of that ragged character that temporary ice dams often form and break away during the winter. These dams produce a sudden rise which extends to the aqueduct two miles above.

From the setting in of winter until March the river level steadily lowers, except when temporarily elevated by the ice dam, so that in the early spring there is the least depth of water at the intake, and the greatest depth of surface ice and saturated snow over the aqueduct, and the only water-way left is at the bottom where the width is least. The ordinary action of snowfalls, winter rains and thaws (the accumulations of three or four months) would of themselves seriously encroach upon the water-way in the widest part of its earth section, but these are (in this case) enormously increased by the sudden rise of the river while the ice is frozen to the aqueduct banks. This ice is overflowed before it can be lifted, and as these winter floods always occur during the severest weather, the overflowing water is immediately frozen, forcing the ice covering of the aqueduct further down until the half of more of the area of its water-way may be closed off.

These winter inundations seldom last long enough to send the river water far down the aqueduct, but their action at its mouth is all that is necessary to affect its power. The first one experienced was during the first winter the works were in operation. Nothing like it has taken place in the forty years which have since elapsed, and it was the only one which extended throughout the five miles of the aqueduct. In January, 1857, after nearly five days of below zero weather, in the middle of the night the water suddenly poured over the flumes in the wheel-house, sending an icy stream over the frozen surface of the ground for miles beyond. This ice-dam on the rapids caused a rise of four feet in a few hours at the aqueduct entrance. Years later this flood might have destroyed the usefulness of the aqueduct for the remainder of the winter, but the power then required was so small that winter difficulties did not arise until a later date, when the conditions were aggravated from another direction—below instead of above, and from another description of ice insidiously creeping into the winter-diminished water-way, due to the causes above described, and producing gradual suffocation. This did not take place until the combination of extreme low water in the river, extreme accumulation of surface ice and snow and increased draught to the wheels so quickened the current at the intake that it attracted the floating frasil or "anchor ice," which immediately that it touched the solid bordage ice at the aqueduct entrance was sucked under and soon arrested where the strangling process was slowly but surely closing the gap.

The lesson of this history is that in such situations, where anchor ice is wont to pass an intake basin is indispensable where possible, so large, wide and deep that the necessary supply for the power channel coming into it from the river will never create a current sufficient to attract the frasil. Anchor ice is only begotten in open water, and this in our climate always means water too swift to become self-freezing; and it will not leave this until enticed from the old paths by stronger currents. It is, therefore, only a question of cost to form a mill pond which it will not invade. Where this is limited, the boom which separates the river from the basin (forming a bordage to the ice cover of the latter) should be made deep enough to prevent the ice which is passing and crowding outside from being forced under it.

An enlargement of the aqueduct was undertaken twenty-five years ago, but it was not carried farther than seven-eighths of a mile from the entrance. It has prevented the incoming of anchor ice and enabled the aqueduct in high water winters to pump its full summer average. But, as the strength of a chain is that of its weakest link, so, for this purpose, the minimum power must be equal to the maximum wants, and auxiliary power will be required until the completion of the enlargement. Enlargement is not likely to be completed until the consumption is so increased that it will become cheaper to pump the whole by water power.

In high water mild winters when there is the minimum of ice obstruction, and an increased depth at its widest section, the aqueduct pumps its full summer average. Thus in March, 1890, it pumped 350 million gallons, while in March, 1893, it only pumped 46 millions, because when the river falls to a certain level all wheels are stopped to prevent further lowering of the ice in the aqueduct. This result would go to prove that, to meet our winter conditions in some situations, an increase of at least fifty per cent. on the necessary summer dimensions would be needed.

Until water power was required for pumping the city water supply, in 1874, there had been no important winter use of the power of the Chaudiere Falls. The large saw mills did not work after November. The few establishments on either side of the river where winter water power was used had no effect on the ice question, nor did the larger demands for the city pumping change the conditions in this respect. The advent of electricity, however, in which three large users of power engaged, revealed the fact that winter difficulties existed where they had not been anticipated. Fortunately, they have not yet seriously affected the city aqueduct, where, in the absence of auxiliary power or reservoir, they might produce a calamity.

The conditions at Ottawa differ from those at Montreal inasmuch as the aqueduct is fed from Nepean Bay, which is ice-covered in winter, and all the other mill-races upon the Ontario side draw under similar conditions. About a mile above these the foot of the Little Chaudiere Rapids is reached, and this is united with another rapid higher up, so that there is over a mile of open river in which anchor ice is manufactured and sent below in successive and frequent crops in severe winters. On the north, or Quebec side of the river, runs the only deep channel between the Little and Great Chaudiere. This is generally open water throughout the winter, and in it much of the anchor ice is carried into "the Kettle" and away from the mill ponds on either side. From this a subsidiary channel of considerably less depth crosses diagonally to Nepean Bay, discharging

into a depression in which there is a depth much greater than that of the channels leading into and out of it, and therefore a slower current. This is the point from which the supply to the city aqueduct is taken, and, in leaving it, the aqueduct begins between piers sixty feet apart placed in twenty feet of water, whereas the section through the rock after it leaves the river bank is only twenty feet wide with about thirteen feet depth of water. The excavation being entirely in rock, this aqueduct has the great advantage, for winter work, of having as great a width at the bottom as at the surface.

It was not known that any frasil passed through this bay under its ice covering, but it was believed that, if, and when it did, the slower current into the aqueduct would not attract it, and that it would pass outside in the main channel leading to the mills below. This has proved to be the case in the twenty-three years of the aqueduct's history, although there has been some frasil in the later years, causing a stoppage of the wheels on one occasion, for a few hours, by which stoppage its presence was first made known.

Unless anchor ice is expected and watched for, the first indication of its presence may be a sudden collapse of the water power. When the Montreal Aqueduct was first corked up at its mouth by anchor ice the wheels ran on until the five miles of canal was emptied, and the ice tumbled in, ruining it, as an aqueduct, for the time being. The same experience overtook the electrical power at Ottawa, and from the same causes, but under different conditions, emphasizing the necessity of local knowledge of bed as well as of the surface of the channels near and above the site of the power.

The whole Ontario side of the river bed is a submerged rocky plateau ten to thirty feet or more above the bottom of the north channel, so that if the river surface here at low water were lowered ten feet it would lay dry the greater portion of the southern half of the river bed, while there would still be deep water in all the north channel above the rim of "the kettle." As at Montreal, in a moderate and high water winter ice difficulties are not experienced, but, in very severe and low water winters, the thickened ice settles down on top of the shoals, reduces the depth and increases the current in the channels between them until one after another is invaded by frasil, coaxed in by the increasing draft towards the water power, and gradually shut off.

In these winters the output of anchor ice is a maximum, while the storage room beneath the field ice is reduced to the minimum. Moreover, as channel after channel is closed, the velocity in the remaining ones is so increased that the anchor ice is carried under miles (it may be) of an ice-covered surface, until it reaches the mill-races.

That anchor ice is carried long distances under the surface of an ice-covered river (or shallow lake with sufficient current) is proved by watching air holes near Montreal, where this ice is seen hurrying past, having come over the Lachine Rapids, below which none is formed after the river becomes ice covered.

On the other hand, in mild and high water winters there is the minimum of ice of all kinds, and the maximum depth of channel, and therefore the slower currents in them, so that anchor ice is arrested by friction under the field ice and frozen thereto, leaving some water-way underneath it.

The best way to fight anchor ice (which is the sole cause of the winter floods in the St. Lawrence) is to abolish it wherever this is practicable. It cannot be got rid of in the St. Lawrence, but could be at Ottawa by a dam at the Little Chaudiere. This could also be done in the Back River behind Montreal by a succession of dams, creating slack water (and water power) if this can be accomplished at a profitable outlay. On most of our tributary rivers this hoary enemy of water power can often be got rid of and a valuable water power created at the same time by means of one or more dams.

THE STEAM ENGINE GOVERNOR AND ITS REGULATION.*

The matter of governing steam engines for a uniform speed under the greatest variation of load and steam pressure, and the economy in the use of steam, is no doubt one of the principal features in steam engineering, and I believe the same is absorbing more thought and receiving more attention from the engineer and engine-builder than any other subject connected with the steam engine to-day. I will now endeavor to point out the fundamental principle upon which the governor acts, and why it acts. There are two principles on which governors are constructed, one known as the centrifugal, and the other inertia action. The ordinary centrifugal fly-ball governor consists principally of a pair of cast iron balls or weights, suspended on an arm and at an angle of about thirty degrees from its vertical axis, and made to revolve round its axis as free as possible, generally driven by a pair of mitre gears. This principle of fly-ball or centrifugal governor was embodied in the first governor invented by James Watt, which has been more resorted to than any other, but aside from this the governor has been so improved and altered, and reconstructed since his time as to be almost unrecognizable, but still the old principle is there, and nearly, if not all, the prominent defects which so materially interfere with its efficiency.

The three principal defects are: First, friction; second, unbalanced force, caused by the different position of the levers and arms; third, unequal resistance, offered to counteract the centrifugal force. Now we will take friction, the first. It may be said it has been fairly well overcome for the most practical purposes, so far as the builders are concerned, but much depends on the engineer, as it is his place to see that no excess friction is allowed through improper lubrication of the working parts and poorly packed valve stems, etc. Second, unbalanced force: This defect appears to be much more difficult to overcome, and is certainly a greater detriment to the action of the governor. Like other parts of the steam engine, some governors are designed much worse than others in this respect, but the best of them are a long way from being perfect, and the reason may be explained in this way: Suppose we take, for example, the ordinary centrifugal fly-ball governor, and assuming the balls are traveling around in their normal plane, and say the arms are now at an angle of 45 degrees and traveling through the path of a 12 circle. The engine is now running 100 revolutions per minute, and the mean effective pressure is 40 pounds. Now, so long as those conditions are left that way, and there is no change in the load, the speed of the engine will be most perfect, but we cannot maintain this, so we will suppose the first change to be that the steam pressure shown by the gauge is allowed to increase. Now then, the mean effective pressure shown by the gauge becomes greater, and the engine then begins to move faster, and the governor in turn. Now there has been a change. The balls have moved to a higher and wider plane. This change simply means that the line of force has become closer to right angles with the vertical axis of the governor, therefore traveling through a greater radius, and the line through the point of gravitation has become further away from the fulcrum, therefore the speed has to be increased to overcome the increased weight of gravity, caused by the change of angularity, and so the engine continues to increase in speed until enough momentum has been stored to balance the balls in their new position. So then it is quite consistent that the force that will support the balls in one plane will not support them in a higher one. Therefore, the speed of the engine must vary when controlled by such a governor. Third, unequal resistance offered to counteract the centrifugal force. This is sometimes applied by a lever and ball, and sometimes by a spring. Where the ball is used we still have the same trouble as in the fault of the second, namely, angularity; and where the spring is used it is much worse than the ball, because the tension of the spring increases as the spring is drawn out. For example: If we have a spring attached, and offered 20 lbs. resistance, when it was drawn out, say one inch. Supposing now that part of the load was thrown off, the balls would then have to be speeded up to a higher plane, say enough to cause the springs being drawn out another inch; then the spring would be holding 40 lbs., and of course the balls would have to be speeded fast enough to support this extra 20 lbs.; possibly this might mean two or three revolutions faster for the engine.

The object of applying resistance to the governor may be said to have two purposes. First, to assist the gravitation of the balls when coming to a lower plane. Second, to permit the changing of the speed of the engine by adjusting the ball or spring until the required speed is maintained. This resistance, however, has been made automatically adjustable by several inventors in the last few years. This has bettered matters considerably, but still the speed of the engine must

* A paper read before the Hamilton branch of the Canadian Association Stationary Engineers, by H. G. Mitchell, President Ontario Association Stationary Engineers.

change before the attachments are caused to act. So as it is, the engine has first felt the change of load, causing it to slow up in speed, then the governor feels the change, which in turn causes the attachment to act; therefore it is just a little too late in acting, as the speed has already slowed up, but if the governor had felt the change before the engine, then things would have been different; and so it is with the centrifugal governor that the momentum has to be increased to act one way, and decreased to act the other way. Now, I will leave the centrifugal governor and take up the other principle of governor, called inertia. As it would make this paper very lengthy to go fully into this, I will only endeavor to touch on a few principal points.

First, we will suppose the inertia to be connected on a shaft governor. The principal part of this apparatus consists of one straight arm with a fixed weight on each end, and pivoted in the centre to a fixed point of the wheel near the centre of the shaft, thus allowing the balls to move in a rotating direction only, and always in the same plane, thereby doing away with the troublesome change of angles, as well as the use of the centrifugal action. There is a spring attached to the arm about the centre of its radius and the other end to the rim of the pulley which surrounds the governor. This spring is used to offer resistance to the acting energy of the rotating weights, and also to assist the momentum in opening the valve. Now, it will be seen that when this apparatus is put in motion the pulley and engine will gradually advance ahead of the suspended weights and continue on so until the valve is adjusted to the proper cut-off to balance the load, and when any extra load is felt by the engine the weights will continue to go on in advance of the engine, thereby increasing the travel of the valve, and permitting a later cut-off. So with this apparatus there is no reversing of motion before the governor responds.

THE TORONTO CITY HALL.

There are some people of so critical a nature that they are invariably opposed to the course of action pursued by all those who are in authority over us. Like the Scotch elder, they can "aye object." These are useful, if objectionable people. They occasionally cause an arrest, which is a public service, and to be commended, even though the everlasting cries of "Stop Thief" disturb our after-dinner nap. The opposite class in the community believes that everything that is is right. He believes in the divine right of kings, aldermen and pickpockets. He always votes for the Government, whatever it may be and is a man such as Cæsar likes, who "sleeps o' nights."

Between the critic who is never satisfied and the man whose creed is, "All's well in the world," THE CANADIAN ENGINEER wishes to pursue a middle course. To praise where we believe praise is due, and to blame where we believe cause for blame can be found; and there is the rub. To the end that we may discover if any cause for blame anywhere exists, we intend to ask a few questions, the answers to some of which would determine the fact. In another issue we will take up the question of praising the praiseworthy features, and they are many, of the city hall.

When Elliott & Neelon accepted the contract for the masonry work on the city hall at $838,061, did they expect to make a profit? If they did, how is it that the architect has spent all but a small sum of this amount, and has not yet quite completed the work called for under this contract?

Are we correctly informed that the execution of the work on the lines laid down in the specification upon which this contract was let would have left a very large profit?

Assuming that this profit would have been made by Elliott & Neelon, why has it not been made by the city?

Has the fact that there would have been some question as to whether Mr. Lennox would have been paid his 4½ per cent. on the amount of the profit anything to do with the fact that it has disappeared?

The specifications call for a wall, which was practically a brick wall with a stone facing. As it stands to-day, the building is a stone building, whose walls are of stone with a brick lining.

Are we correctly informed, when we are told that there is 10,000 feet less radiating surface now in the building than the specifications for the heating plant called for? Such a change as this would, of course, only make a small difference in the total, amounting to between $3,000 and $4,000, and we understand that Mr. Lennox is empowered to make any changes that he may see fit.

Of course, such changes will be allowed for and may offset other changes which would otherwise figure as extras.

A short time ago when the architect was instructed to forthwith prepare plans for the dado of the entrance hall, he declined to do so on the ground that he had to accompany a contractor to the United States to select some appliances for the building. In the ten years in which the plans have been in course of alteration, it would appear possible to have prepared even alternative sets of such detailed drawings as these.

Does the architect journey to and fro, assisting all contractors to select their material, and if so, at whose expense?

THE NIAGARA POWER COMPANY.

We have all along expressed the hope that the Ontario Government would take some decided action to undo the great wrong which they committed when they handed over the water-power at Niagara Falls to an alien company, and one whose best interests were served by the least possible development on the Canadian side of the river The session has been allowed to pass and nothing has been done. The only indication of any intention or desire on the part of the Government to make of the resources of Ontario anything greater than a pleasure ground for the United States tourists, or dividend earners for United States capitalists, is the following letter written by the Hon. A. S. Hardy, Premier of Ontario, to F. W. Hill, mayor of Niagara Falls, Ont., a short time ago:

Toronto, Jan. 19 1898.

DEAR SIR,—In reply to your question as to whether it is the intention of the Government to grant to the Canadian Niagara Power Company an extension of time for either the beginning or completion of their work on this side of the Niagara River, I beg to say that in April, 1897, in reply to an application, the company was informed that the agreement made no provision for an extension of the time for either the beginning or the completion of the work, and that it did not appear possible to the Lieutenant-Governor-in-Council to grant such an extension. This appeared to be accepted by the company as final and conclusive, and no further application has been made since then I feel quite at liberty to say that there is no change in the policy of the Government on this point, and that should a further application be made for an extension it is the intention of the Government to adher to this policy and to the terms of the contract.

I am, etc.,

Very truly yours,

A. S. HARDY.

F. W. HILL, Esq., Mayor Niagara Falls, Ont.

The question still remains an open one, for so far the Company has complied with the terms of its contract, work was begun within the stipulated time, and the only hope of the promise contained in this letter being carried out, that the company does not carry out the work within the date set within the contract. It is merely a question whether it wishes to hold the monopoly or not; with the resources in men and money which the company can command, it would be possible to deliver the required number of horse-power within the time specified, but the performance of the work in the time which is now left would be exceedingly expensive, and could not be done to the best advantage

If the Niagara Falls monopoly wishes to retain the industry of southern Ontario in its death dealing grasp, it can do so. If it does not so wish, Premier Hardy will not compel it. That is what the letter may be said to mean.

LITERARY NOTICES.

"British Columbia and the Canadian Yukon Year Book" for 1897, by R. E. Gosnell, Librarian and Secretary, Bureau of Statistics, Victoria, B.C., has just been issued. It is one of the most comprehensive works on British Columbia published in recent years. It contains over 500 pages, eighty of which are occupied by representative illustrations. There is a series of specially engraved maps, and eight lithographic diagrams illustrating British Columbian progress. A special chapter is devoted to Klondyke and the Canadian Yukon, with latest map issued, showing routes. The table of contents is arranged under headings, such as Historical Review, Parliamentary and Judicial, Municipal, Educational, Indians, Physical Characteristics, Forests, Fisheries, Agricultural, Mining, Sociological, Trade, Railways, Canadian Yukon, etc., etc. Price (postage free), in cloth, $2 50; in paper, $2.25. R. E. Gosnell, Librarian Legislative Assembly, Victoria, B.C.

We find in the Methodist Young People's paper *Onward* the following expressions about the Canadian press. Our readers will have no difficulty in recognizing the *Montreal Witness* as the paper specially referred to: "Nowhere, we think, is there a press of higher moral tone than that of our beloved country. It possesses, we think, the unique distinction of having a leading journal in its largest city which for over fifty years has been a moral crusader, a champion of reform. In all that time it has not published one liquor, or tobacco, or theatrical advertisement. At the sacrifice of much money it has stood true to its high principle, and stands foursquare, a tower of strength, against all the winds that blow."

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The following papers are expected to be read at the annual meeting of the Association of Ontario Land Surveyors: "Drainage," John H. Jones, O.L.S., Sarnia; "Irrigation Works on Dominion Lands," A. W. Ponton, O.L.S., Regina, Ass.; "Unrecorded Original Field Notes," J. J. Murphy, Crown Lands Department, Toronto; "Acetylene Gas and its Uses," V. M. Roberts, O.L.S., St. Catharines; "Evidence," M. J. Butler, O.L.S., LL.B., Napanee; "Lake Erie Survey, Otto J. Klotz, O.L.S., D.L.S., Ottawa; "Sudbury Water Works," S. V. Rorke, O.L.S., Sudbury; "Use of Field Tile for Large Drains," W. M. Davis, O.L.S., Woodstock; "The Economic Resources of the Hudson Bay District," J. W. Tyrrell, O.L.S., Hamilton; "Assessment Plans," P. S. Gibson, O.L.S., Willowdale; also papers by Jas. Hutcheson, O.L.S., Guelph; F. W. Farncomb, O.L.S., London, and several others. The date of annual meeting of the association is fixed for 22nd February, but arrangements are being made to meet on that date *pro forma* and adjourn to 8th March. The Board of Examiners will hold its annual meeting at the Department of Crown Lands, beginning 14th February.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

On Saturday evening, January 15th, in Temperance Hall, Bathurst street, Toronto, Toronto Branch, No. 2, C.A.S.E., was duly opened and the following officers installed by Executive President E. J. Philip, assisted by the officers of Toronto No. 1: Past President, P. Trowern; president, John Dixon; vice-president, John H. Venables; recording secretary, Thomas Graham, 570 King street west; financial secretary, J. Richardson; Treasurer, Joseph Hughes; finance committee, F. Tushingham, E. Thomas, T. L. Holmes; trustees, John Dixon, J. McMulken, P. Trowern; conductor, M. Connolly; doorkeeper, H. Brown. Immediately after the installation ceremonies were over President Dixon delivered his maiden speech, and, in conclusion, invited the visiting brethren from Toronto No. 1 to partake of refreshments, which were duly appreciated and ample justice done to the elaborate supper, which was served by the wives and daughters of the officers. After the usual toasts, speeches and songs, the gathering dispersed with the singing of "Auld Lang Syne."

The regular meeting of Toronto No. 1, C.A.S.E., was held January 19th. There was a large attendance, and one initiation. The committee appointed to get up the annual At-Home and reopening of the hall reported that all arrangements had been completed to hold the At-Home on Thursday evening, Feb. 3rd. A general good time is guaranteed. Tickets, 25 cents. There is to be a concert, refreshments, dancing, and other amusements. The trustees reported that they would have to draw on the association funds, the insurance allowance not being enough to finish furnishing and decorating the hall, but when complete the engineers will certainly have one of the finest suites of rooms in the city. Bro. Wickens will continue his paper on the "Indicator" at the regular open meeting on Tuesday, February 8th. All engineers and manufacturers are invited to be present.

—We have received the fifty-first volume of the Canadian Almanac from the publishers, Copp, Clark Co., Limited, Toronto. Besides being a directory of clergy, militia, Government officials, members of Parliament, county and municipal officers, schools and colleges, barristers and solicitors, and other public men, it is a compendium of information of all kinds relating to Canada. Some of the more prominent departments are: Short History of Canada, Tariff of Customs, Forms of Government throughout the World, Post Office Gazetteer, Masonic Lodges, Miscellaneous Societies, Historical Diary, Life Insurance. Some new features for 1898 are: Short Accounts of the British Army and the British Navy, with illustrations; also articles on the English Government, and Extradition and Pardons. Besides the above, with every copy of the Canadian Almanac for 1898 is presented a map of North America, beautifully engraved and printed in five colors. The price, 25 cents.

—W. B. McKenzie, chief engineer of the I.C.R, has an article in the New York *Engineering News* recently, on the "Tidal Marshes of the Bay of Fundy." Between the Bay of Fundy and the Strait of Northumberland lies a strip of low land 15 miles wide. During the post-tertiary submergence, this part of the country was 220 feet below its present level, and the Champlain and the Saxicava sands were being deposited on the sea bottom. Tides of the ordinary height, 10 to 15 feet perhaps, swept across into Northumberland Bay. Mr. McKenzie states floating ice was carried in both directions and has left its deep grooving on the bordering shore. Several shore terraces, now standing high above the sea, tell that the land rose spasmodically. When the 'divide' appeared, the Isthmus of Chignecto was low, and the eastern part was no longer an island. The tidal wave was thrown back upon itself, and while recovering from the shock lost part of its load or sediment. Since then, the tides have been depositing this material and filling up the valleys and fresh water streams flowing into the Bay of Fundy, forming these great prairie-like salt marshes which now constitute much of the agricultural wealth of New Brunswick and Nova Scotia.

Industrial Notes.

THE Stempel Fire Extinguisher Company has removed from Berlin, Ont, to Toronto.

THE Paris Electro Plating Company, Paris, Ont, has sent its friends an attractive calendar.

THE employees of the Westinghouse Air Brake Co, Hamilton, Ont., are working 13 hours per day.

THE Stouffville, Ont, waterworks were tested January 14th, and gave complete satisfaction it is reported.

EDISON FITCH, Etchemin, Que., will shortly build a new woodworking factory, stone, 134 x 43 feet, to cost $12,400.

THE Stratford Bridge Co. is building a highway bridge 110 feet long at Greenfield, Waterloo county, Ont.; cost, $1,084

HARVEY & Co., merchants, St. John's, Newfoundland, have started up their pulp factory, at Black River, Placentia Bay.

THE Goldie-McCulloch Co., Limited, Galt, Ont., will enlarge its offices and extend the molding shop, owing to the enlarging business

THE by-law granting a bonus of $62,000 to the Abbott Rolling Mills Co. was carried in Kingston by a very large majority, Jan 13th

THE Smith Axle Works Co. is consolidating its business in Guelph, Ont, some carriage hardware formerly made in London being now manufactured there.

THE thirteenth annual meeting of the Illinois Society of Engineers and Surveyors, was held in the Court House, Peoria, Illinois, January 26th, 27th and 28th, 1898.

THE officers of the Halifax Board of Trade for the year are: President, Geo. Mitchell, M.P.P.; vice-presidents, W. A. Black and J. E. DeWolf; treasurer, H. G. Bauld.

A LICENSE has been granted the Norton Manufacturing Company, of Illinois, U.S.A, to manufacture and sell sheet-metal goods and other articles in the Province of Ontario.

MCOUAT & MCRAE, machinists, Lachute, Que., have put on extra hands to fill an order for six pulp grinders and other machinery for Hamelin & Ayres' new pulp mill in that town.

A. WATSON, A. and Wm. McLachlan, A. H. Deike, Elizabeth J. Deike and J. Mitchell, Guelph, Ont., have applied for incorporation as "The Guelph Acetylene and Gas Generator Co., Limited."

THE officers elected for the year by the South Kootenay Board of Trade, at Nelson, B.C., are: President, John A. Turner; vice-president, H. J. Evans; secretary-treasurer, H. B. Thompson.

THE officers of the Chatham, N.B., Board of Trade for the year are: W. S. Loggie, president; W. B. Snowball, vice-president; J. D. B. F. Mackenzie, secretary; George Stothart, treasurer.

WE have received a neat little calendar from the McLaren Belting Co., of Montreal and Toronto, accompanied by a handy price list of belting, card clothing, studs, pulleys, and the various other articles dealt in.

THE city of Belleville, Ont., is inviting correspondence with manufacturers desiring to establish new industries or extend existing ones. Liberal terms are available for substantial firms desiring a location in Belleville.

JOHN BENN, proprietor and manager of the dynamite works at Tweed, Ont, has sold out to Daniel Smith, Montreal. The new firm will be known as the Ontario Powder Works. Mr. Benn will be retained as manager.

THAT the goods manufactured by the Goldie & McCulloch Co., Limited, Galt, are gaining a wide reputation, is evidenced by the fact that the company has recently received an order from a London, England, firm for blocks and tackle.

THE sheriff took possession of the Toronto Junction Foundry Co., Limited, a short time ago, which was incorporated last year with an authorized capital of $24,000. Of this sum $8,700 was paid, but this proved insufficient. The business will be wound up.

LETTERS patent have been issued to J. Goodison, J. F. Lister, C. Mackenzie, E. F. Goodison and W. T. Goodison, Sarnia, as the John Goodison Thresher Company of Sarnia, Limited, to manufacture and sell threshing machines and agricultural implements, with a capital stock of $90,000.

THE company which is negotiating with St. John, N.B, for starting a pulp factory at Mispec, near St. John, was registered at Edinburgh, in December. The directors are:—J. Galloway, W. Dixon, F. Wallace, P. Grosset and C. Anderson, all of Scotland. Registered office, Royal Bank Buildings, Leven, Fife.

BOWMANVILLE, Ont., will buy a fire engine.

WALLACEBURG, Ont., is to have a new $8,000 hotel.

THE Woodstock, Ont., town council will buy a fifteen-ton road roller.

LONDON, Ont., erected new buildings last year to the value of $270,000.

PORT COLBORNE, Ont., voted approval of the waterworks by-law last month.

THE new water system at Cowansville, Que., was satisfactorily tested recently.

THE Canada Switch and Spring Co., Montreal, has installed a Bessemer steel plant.

THE Hamilton, Ont., Waterworks Department shows a surplus for last year of $5,000.

SHELDON & SON, Aylmer, Ont., iron founders, are moving into larger premises, it is reported.

THE Berlin, Ont., Waterworks Company is going to put in a system in Waterloo, Ont., this season.

C. N. ROBERTS has been engaged to take charge of the waterworks pumping plant at Renfrew, Ont.

A GOOD roads convention was held at Sweetsburg, Que., last month, which was addressed by A. W. Campbell, the Ontario road instructor.

ELIAS ROGERS has been elected president of the Toronto Board of Trade by acclamation, and A. E. Kemp vice-president, also by acclamation.

THE Graham Nail Works, Toronto, has installed recently a 35 h.p. gas engine, which it is estimated will effect a large annual saving in running expenses.

EIGHT new elevators have been built on the line of the Calgary and Edmonton Railway in one hundred miles north of Red Deer during the past season.

HOUSE & FISK, Lansing, Mich., are corresponding with Galt Ont., about starting the manufacture of the Patterson acetylene gas generator in that town.

NEGOTIATIONS between the refiners of Petrolia and a group of English capitalists, looking towards the consolidation of the refining interests, are still going on.

W. J. KNOWLES, late vice-president of the Goold Bicycle Company, Brantford, Ont., is organizing a new company for the manufacture of bicycles in Canada.

THE Kerr Engine Works, Walkerton, Ont., recently supplied the waterworks commission, Kaslo, B.C. five fire hydrants, nine 6-inch gate valves, four 3-inch gate valves, thirteen valve boxes.

THE tender of the Dominion Bridge Company for the erection of a new iron bridge over the St. Francis, in place of the old Aylmer bridge, Sherbrooke, Que., was $8,386; weight, 284,000 lbs. Accepted.

THE Chatham, Ont., Dredging Company has been notified by the township of Tilbury North that it has been awarded a contract for dredging Trembly Creek, which will amount to $4,000.

As a result of favorable votes, last month, on by-laws to establish a House of Refuge in Bruce County, carried in Lucknow, Walkerton and Kincardine, such a building will no doubt be erected at an early date.

THERE was recently cast at the Londonderry, N.S., Iron Works, a pipe 42 inches in diameter, made of Nova Scotia iron, and weighing nearly three tons. It was ordered for a culvert on the P. E. Island Railway.

THE sources from which Rossland, B.C., proposes to secure a water supply are Stoney Creek, 470 gallons per minute, from an elevation of 375 feet, distance 4 miles; and Murphy Creek, 500 gallons per minute, from an elevation of 600 feet, distance 10 miles.

THE Maritime Sulphite Fibre Co. have completed a mill on the Canada dock, Chatham, N.B., for cutting, barking and preparing wood for the grinder in the pulp mill, and another similar mill is in course of construction. In operation each mill will employ about 25 hands.

IT has been decided to liquidate the Taylor Iron and Steel Co., Limited, Montreal. The company was chartered about a year and a half ago to take over the business formerly carried on in boiler tubes and general steamfitters' supplies, by J. & H. Taylor. The liabilities are under $10,000.

INCORPORATION has been granted to The Hamilton Acetylene Gas Machine Company, Limited, with a capital stock of $45,000, and these members: G. S. Bingham, Mrs. A. Seguin, F. A. Carpenter, W. R. Moore and S. D. Biggar, of Hamilton, and J. D. Forsyth, of Claremont, Ont.

AN English syndicate has been formed, it is said, to erect palatial hotels at Halifax, Montreal, Ottawa, Toronto and Niagara Falls. The plans also include a big hotel in London, England, that will cater to the colonial trade.

LETTERS patent have been issued to R. McDougall, Thomas McDougall, A. J. Oliver, R. McDougall, Jr., and Elsie McDougall, Galt, Ont., as the R. McDougall Company, Limited, to manufacture and sell hot-water, steam-heating and ventilating apparatus, and carry on business generally as iron founders.

THE Kingston and Montreal Forwarding Company has closed a contract for the construction of an elevator at Coteau Landing of a capacity of 500,000 bushels. The contractor is under heavy bonds to have the elevator ready to receive grain not later than May 10th next. There will also be a large warehouse in connection with the elevator.

C. H. TAYLOR, of the Taylor Hydraulic Air Compressor Co., Montreal, has returned from British Columbia, where he arranged for installation of a 500-h.p. plant, at Ainsworth, B.C. Contracts have been let and the work is rapidly progressing. The power is to be sold to mines within a radius of five miles of the compressor at a low rate.

THE gifts of W. C. McDonald to McGill University now amount to close on a million and a half dollars. The equipments of Mr. McDonald's three buildings are the most modern, as well as the finest, in America, and the endowments are such as contemplate their remaining always modern. These gifts make Montreal the envy of other cities.

C. H. ACTON BOND and Sanford Fleming Smith are the members of a new firm of architects in Toronto. Messrs. Bond and Smith have had several years' experience in New York, and are specially well qualified by their experience in that city to undertake the steel construction which is now so much employed in large buildings. The firm has at present four residences in Peterboro, Ont., and one in Ottawa under contract.

WE have received from P. S. Gibson & Sons, of Willowdale, Ont., the engineers of the Township of York, their report on the state of public works in the townships of Coleman, Todmorden, Deer Park, Bracondale, Swansea, Lambton Mills, Mount Dennis, North of Weston, Downsview, etc. It deals with needed extensions in sidewalks, the condition of those long in use, and lighting, and contains a pronouncement by the township solicitors on the responsibility for damage done by traction engines.

A. ROBILLARD, St. Andrews, Que., is the inventor of a new system of operating swing bridges for canals, railways, etc. It dispenses with the central shaft, or axle, as well as with the wheels. Instead of these, Mr. Robillard introduces a ball-bearing system. The surface friction is thus reduced to a minimum, requiring one man to operate it where it now requires several. Another feature of the invention is an automatic system of opening and closing the gates at the entrance to the bridge. As soon as the bridge commences to swing open, the gates close, and the movement which closes the bridge causes the gates to open.

THE fact that iron is being exported from the United States to Europe is said to be influencing the proprietors of the Nova Scotia Iron Works at Ferrona, in Pictou county, to discuss the removal of the works to Louisburg, Cape Breton. The original object in locating the works at Ferrona was to be alongside the deposit of ore supposed then to exist there, and also to be near coal and limestone. But the deposits of ore were not extensive, and now nearly all the ore used comes from the company's ore beds in Newfoundland. It is further said that Pictou county coal is not so well suited for smelting as is Cape Breton coal. In fact, the company made practical tests of the latter, with the result that they ordered something like 10,000 tons. This had to be taken from Louisburg to Pictou Landing by water, and then to Ferrona by rail. By locating at Louisburg the company would be alongside the kind of coal they require, and would be saved the haul by rail of their ore from Newfoundland. They would also have an advantage over Alabama competitors in the matter of freight, the latter being handicapped with a haul of several hundred miles to the seaboard and a longer ocean journey. At the meeting of the company held at Halifax a short time ago, the project was discussed, we are told, in all its bearings. The authorities of Sydney, having heard of the possibility of removal, made proposals that Sydney, not Louisburg, should be chosen, because it offers advantages in point of situation, railway and shipping facilities, etc., fully as great as Louisburg, while a proposal of exemption from taxation, or cash bonus, has been made by resolution of the town council, to any "coal mining companies or other companies which will locate their workshops, offices and shipping piers on the peninsula of Sydney." If it should prove to be the intention of the company to locate their works in Cape Breton, with the object of making pig iron for export abroad, it would seem to be well placed and circumstanced for such an enterprise, either at Sydney or at Louisburg.

JOHN JOHNSTON, a lumberman of Orillia, is building a planing mill at Ahmic Harbor, Ont.

THE Mac Machine Company has decided to remove its plant from Trail to Rossland, B.C.

THE shareholders of the nail factory, St. John's, Nfld., received a dividend of 6 per cent. on last year's business.

THE G.T.R. foundry, employing about 75 to 100 men, in Hamilton, Ont., has been closed down; part of the plant will be removed to Montreal.

S. CARSLEY, dry goods merchant, Montreal, is going to rebuild the old Canada Life building, St. James street, Montreal, in white marble as a store.

THE officers of the Berlin, Ont., Board of Trade for the year are: President, C. K. Hagedorn; vice-president, G. V. Oberholtzer; secretary, J. S. Hoffman.

AT the annual meeting of the Brantford, Ont., Board of Trade, Henry Cockshutt was elected president; T. H. Preston, vice-president; George Hately, secretary-treasurer.

A WRIT has been issued against the Welland, Ont., council of 1897, by the Waterous Engine Works Co., claiming damages for the non-fulfilment of the contract to purchase a fire engine.

G. BROWN, Westmeath township, Renfrew county, Ont., has been awarded the contract for building the bridge across the Colounge River, near Colounge, Que. The contract price is said to be $6,000.

THE building of the Simcoe County House of Refuge was awarded to A. Tessier, of Penetanguishene, for $14,966, exclusive of plumbing and heating. J. R. Eaton's tender was $18,914, without the plumbing.

CORNWALL, ONT., and Hull, Que., are in correspondence with the Toronto Rubber Company, which proposes to remove its Port Dalhousie factory to some locality where a water-power of three or four hundred horse-power can be obtained. The company pays out about $100,000 per annum in wages.

C. W. YOUNG, who has been president of the N.B. Granite Works at St. Stephen, N.B., for the past several years, has bought the business, and will run it under the same name. He has also bought the shot tower, which is situated near the mill, in which the shot necessary for the work of polishing the stone is manufactured.

THE engineering trades strike in England was ended at a meeting of the committees representing the federated employers and the allied trades unions on January 29th, when the result of the ballot accepting the employers' terms was communicated, and a formal agreement embodying the terms of the settlement was duly signed and arrangements were completed for a simultaneous resumption of work in all the federated workshops.

No. 13 St. Sacrament street, Montreal, in which the Montreal Stock Exchange is located, is to be rebuilt. David Ogilvie is the architect in charge, and the Dominion Bridge Company has already been awarded a contract to put a steel frame in the building, which will receive an additional story or two. The new walls and floors will be of marble and tiling. The woodwork is to be of white ash, and the elevators will be electrical. There will also be an ornamental iron stairway.

SIX important amendments to United States patent laws came into force on January 1st, 1898, which in substance are as follows: 1st. A patent will not be granted to an applicant if the invention has been patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to his application. 2nd. A United States patent will not be granted to an inventor who has obtained a foreign patent, unless his United States application be made within seven months of the date of filing of the foreign application. This clause, it will be noted, only applies when the foreign patent has actually issued, and is not merely applied for. 3rd. The application must be completed and prepared for examination within one year after the filing of the petition, and must be prosecuted within one year of the date of any official action thereon. 4th. The prior issue of a foreign patent will not now limit the United States patent to expire at the end of the legal term of the foreign patent. 5th. If an assignment, grant or conveyance be duly acknowledged before a proper officer, the certificate of such acknowledgment under the hand and seal of such officer will be *prima facie* evidence of the execution of such instrument. 6th. No damages can be collected for infringements of a patent occurring more than six years previous to the filing of a bill of complaint or the issuing of a writ. The second amendment referred to is of immediate importance to Canadian inventors, and it is desirable that they thoroughly understand it, so that on one hand they may make their United States applications in due time, and on the other be prepared to meet the attempts of unscrupulous United States firms to entice them into making worthless United States applications.

THE Page Wire Fence Co. has received an order from the Atlantic and Lake Superior Railway Co. for two hundred miles of standard railway fencing. This amount of fencing will make about thirty car loads.

Electric Flashes.

M. B. QUINN, Windsor Mills, Que., has built a flour mill which is operated by electricity.

IT is stated that the Royal Electric Co., Montreal, will shortly absorb the Montreal Gas Co.

THE Canadian General Electric Co. has sent out to its friends a very handsome wall calendar showing a view of the works at Peterboro, Ont., and gold background.

COMMUNICATION by the new cable between Turk's Island and Halifax, by way of Bermuda, was established Jan. 17th, and business despatches are now being transmitted.

THOS. EDISON, JR., has planned an apparatus for generating electricity from the wave motion of the ocean by means of floats which would operate an air compressor.

THE corporation of Magog, Que., has placed an order with the Canadian General Electric Company for a 2,000-light alternator of their single phase, revolving armature compounded type.

THE Northey Manufacturing Company, of Toronto, has increased the capacity of its incandescent lighting plant recently purchased from the Canadian General Electric Company from 250 to 350 incandescent lamps.

THERE is a move on foot to get an electric railway service for the Island of Orleans, near Quebec. It is reported that a charter will be asked for at the next session to construct an electric railway around the island. The power is to be obtained from the Montmorency Falls.

MUCH surprise has been expressed in the trade because Hon. J. I. Tarte let the contract for four Westinghouse 40 horse-power electric motors, and four Worthington pumps, one of each of which are to be placed in the East, West, Centre and Langevin blocks of the Parliament Buildings, at Ottawa, to Ahearn & Soper, Ottawa, for $30,000, without calling for tenders.

THE street cars in Toronto have been equipped with a new appliance which does away almost entirely with the use of the immense snow sweepers. The digger is a contrivance that attaches to the machinery of the car, and by pressure from the motorman, digs down into the groove of the rail and cleans out the snow. It is the invention of Foreman Power of the Toronto Railway Company's car building shops.

IT is understood that Engineers Keating, Toronto; Pearson, New York, and Wanklyn, of the Montreal Street Railway, have visited the new Chambly works with a view to report upon the feasibility of using that power for the Montreal Street Railway, which, in producing its own power, reaches a rate very nearly $42, or $360,000 per annum, while the Chambly people have, it is said, offered to furnish the company with power at the reduced figure of $32, which would mean a great deal to the shareholders.

WORK was begun on the power house of the Hamilton Cataract Power Company, near Decew Falls, Jan. 8th, and it is being pushed towards completion. The building is to stand within a few feet of the edge of the stream, and above high water level, where the precipitous banks rise nearly 275 feet above the level of the stream. When completed, the power house will be 174 feet in length and 42 feet in width, and the walls 30 feet in height. It is to be constructed throughout of steel, faced with brick, and have concrete floors. The stone is quarried on the spot, and the cement is supplied by Battle Estate, Thorold. Angus McDonald & Co., Hamilton, are contractors for the construction of the canal, power house, etc.

THE Guelph Light and Power Company has decided to replace the arc lighting machinery for supplying the street circuits with the latest and most approved machinery for the purpose, and has placed an order with the Canadian General Electric Company for an 80-light Brush arc machine, equipped with automatic regulator. These large Brush machines, of which eight having a capacity of 125 lights each, have been purchased by the Toronto Electric Light Company—four of the same size by the Montmorency Company of Quebec, and four for direct connection to synchronous motors by the Lachine Rapids Hydraulic and Land Company—are believed to represent the successful development of arc lighting machinery along the lines which have been established as approved practice in direct current and alternating work.

Now that the waterworks are assured for Port Colborne, Ont., an agitation is on foot for electric light.

MANAGER LEATHER, of the Hamilton Radial Electrical Railway, says his line will be extended to Bronte by May 1. The railway has been built into Burlington.

THE Toronto & Hamilton Electric Co., successors to Kay Electrical Mfg. Co., reports that among recent sales are the following twenty machines to different parties: Hallman & Co., Berlin, one 12 h.p. motor; Toronto Cold Storage Co, one 50 lt. dynamo; *Journal* Printing Co., St. Catharines, Ont., one 5 h.p. motor; Geo. Membery, St. Catharines, Ont., one 3 h p. motor; Toronto Ornamental Iron Co., one 1,000 gal. plater; Meakins & Co., Hamilton, one 1 h.p. motor; R. N. Grundy, Guelph, one 200 gal. plater; Berlin, Ont., Felt Boot Co., one 150 lt. dynamo; Victoria Wheel Works, Galt, Ont., one 150 lt. dynamo; Messrs. A. R. Woodyatt & Co., Guelph, Ont., one 250 gal. plater; J. C. Harris, Toronto, one 7 h.p. motor; McKinnon Building, Toronto, one 2 h p. and one 10 H. & P. direct connected motors and controllers; Garrioch & Goddard, Ottawa, one 2 h.p. and one 4 h.p. motor; Berlin Shirt and Collar Co., one 4 h.p. motor; D. W. Karn & Co., Woodstock, one automatic organ blowing machine, besides several machines in Victoria, B.C., and Woodstock, N.B.

A REPORT of the Commissioner of Inland Revenue dealing with the official inspection of weights and measures, gas and electric light, recently issued, contains sundry items of general interest. The progress which has been made in lighting by electricity is well illustrated by the statement that there were one hundred and eighty-seven electric light companies registered under the Inspection Act during the year ending on the thirtieth of June, 1897. The first in importance, measured by the number of lamps in use, and reckoning each arc light as equal to ten incandescent, is the Royal Electric Company, of Montreal, which heads the list with 1,450 arc and 58,000 incandescent lights, or a total equivalent to 72,500. The Ottawa Electric Company comes next with 550 arc and 57,240 incandescent lights respectively, or a total of 62,740. Third on the list is the Toronto Electric Light Company, with 1,400 arc and 45,000 incandescent lights, or a total of 59,000. The Montmorency Electric Power Company, of Quebec, follows with a total of 17,080, below which the figures decline rapidly. Contrary to what might reasonably be expected, only one company, and that with an evidently very limited patronage, is registered at Winnipeg. During the year 3,208 electric light meters were presented for verification. Of these, 3,111 were passed, "as coming within the error tolerated by law," 698 are tabulated as actually "correct," and 1,633 others of these "verified" meters are classed as "fast."

FROM the plant which the West Kootenay Electric Light and Power Company is erecting at Bonnington Falls, B.C., it is expected that transmission of power to the Rossland mines will be commenced early in February. Robert Jamieson is general manager and engineer for the company. L. A. Campbell, engineer of the Canadian General Electric Company, is erecting the generators at the power plant. Bonnington Falls, where the power house is located, lies about 11 miles below Nelson, B.C., on the Kootenay River. Water is conducted to the reservoir from the river by a canal 22 feet deep, cut out of the rock for a distance of 640 feet. The dam, which is of concrete, is 32 feet high and 18 feet thick at the base. It extends across the fore-bay, some 54 feet, and is reinforced on the sides by abutments of concrete. The average rise of the Kootenay River is 22 feet, and the highest flood on record was 32 feet above the minimum height of the stream. From the fore-bay the water is carried to the turbine wheels by three steel pipes, two of which are nine feet in diameter, while the third is a foot larger. At present only the two former tubes will be used. The wheels, which are two in number, are of the twin horizontal type, manufactured by the Stillwell-Beirce-Smith-Vaile Company of Dayton, Ohio, and will develop 1,250 horse-power each, so that their united force is 2,500 horse-power. The turbine wheels are attached direct to the generators. There are two generators, having together a capacity of 2,500 horse-power, made by the Canadian General Electric Company, and of the three-phase revolving field type, wound to generate at a voltage of 1,040. They operate at 180 revolutions per minute. The exciters used in connection with the generators are operated by two separate turbine wheels. The step-up transformers increase the voltage from 1,040 to 20,000. The current is conducted to the sub-station at Rossland over a three-wire line 30½ miles long. The local sub-station, which is situated on the Monte Cristo ground, is equipped with step-down transformers, which reduce the voltage from 20,000 to 2,080 volts. From the sub-station power will be conducted to the various mines which will utilize electricity for motive power. At present it is not intended to use electric drills, but instead it will operate the compressors, and the compressed air will be used throughout the mine as at present. Oliver Durant, the general manager of the Centre Star Mining Co., is the president of the power company.

Personal.

THOMAS J. LOCKE, of the Coast Railway engineering staff, has been appointed assistant engineer at Halifax, N.S.

R. B. MCCREARY has been appointed street engineer of Arnprior, at a salary of 30 cents per hour while on duty.

E. H. KEATING, C.E., city engineer, Toronto, has resigned to become manager of the Toronto Street Railway.

J. WOODMAN, Winnipeg, has been appointed engineer of the C.P.R, western division, *vice* D. A. Stewart, deceased.

JOHN MORROW, of the Machine Screw Company, Ingersoll, Ont., died last week, having been in ill health for two years.

W. J. SPROULE, assistant engineer to the Harbor Commissioners office, Montreal, has been elected mayor of St. Lambert, Que.

SIR CHARLES HUTTON GREGORY, the well-known engineer, and a former president of the Institution of Civil Engineers, Great Britain is dead.

H. W. TRUE has been appointed manager of the People's Heat and Light Co., Halifax, in succession to Peter Young, who goes to Pittsburg, Pa.

THOMAS MESTON, secretary-treasurer of the Hamilton Bridge Company, died at his home in Hamilton, Ont., a short time ago. He was 44 years of age.

THOMAS PETES was instantly killed at Steinhoff & Gordon's stave and hoop mill, Wallaceburg, Ont., a short time ago, by being caught in a shaft. The body was terribly mangled.

ST. ANDREW'S SOCIETY, Dundas, Ont., has been reorganized, John Bertram president. The president has been given the custody of a genuine Burns' snuff box of mahogany wood.

ON December 22nd, Harry A. Moore, B.A., superintendent of the Electric Light and Power Company, Trenton, Ont., was married to Miss Charlotte Greenwood, of Whitby, Ont.

R. EVANS, foreman of the Niagara Falls Metal Works machine shop, has gone to London, Eng., to take a position at $2,000 per annum. The metal works are being worked overtime at present.

T. F. FOLEY, of the firm of Holliday & Foley, of the Stratford, Ont., Bridge and Iron Works, extensive bridge builders, died recently of scarlet fever. He was an esteemed and popular young business man.

F. G. B ALLAN, superintendent of cement works, Napanee Mills, Ont., had a very severe shaking up lately by falling into the mixer. When rescued he was holding on to one of the arms of this tremendous machine.

P. A. DICKENSON, for a number of years head electrician of the Brantford, Ont., Electric and Operating Co., is leaving the city to engage in mining operations with the Mineral Point Mining Co., of Ashcroft, B.C.

T. MATTHEWS, while at work at the axle works, Woodstock, recently, met with a painful accident. A piece of steel flew from the hammer and struck him on the arm between the elbow and the wrist. It lodged about two inches deep in the flesh.

CAPT. WM. HALL, the superintendent of the Le Roi mine, Rossland, B.C., was killed, January 5th, by falling down the main shaft from the surface to the six hundred foot level. The body was terribly injured by the fall, and the remains were hardly recognizable.

DANIEL BOWERMAN, proprietor of Hallowell mills, about two miles east of Picton, Ont., was found dead in his mill last month. Marks of the cogs of a wheel were found on the side of his head. The wheel is supposed to have struck him while engaged in fixing the machinery.

ROBT. HEWITT, of the firm of R. Hewitt & Son, Phœnix Foundry Co., died at Markham Ont., a short time ago, of pneumonia, after a short illness. He was born in Cumberland county, England, in 1818, settled in Markham in 1855, and has conducted the business of the Phœnix Foundry for 30 years.

W. J. OLIVER, a pattern maker at the pulp mills at Sault Ste. Marie, Ont, crossed to the United States side one evening recently to attend a religious service. In going home he fell over the old Michigan canal bank to the lock chamber, a distance of fifty feet, and was killed. His family lives at Carleton Place, Ont.

FRANK RIDDELL, the foreman of the Imperial Oil Co.'s paraffine department at Petrolea, Ont., was presented a short time ago with a gold headed walking stick as a slight token of esteem by the employes. F. Ireland read the address, and W. Wilkinson made the presentation, while Bruce Dunlop acted as chairman.

An application for the city engineership of Toronto has been received from Stewart Howard, C.E., Montreal, who was formerly resident engineer in Toronto for the Northern Railway, and subsequently, while in the service of the C.P.R., designed and constructed the western entrance of that road into Montreal.

Arthur F. White has gone from Toronto to England. For the past two years Mr. White has been mechanical superintendent of the Hyslop tricycle factories, and was formerly lecturer in machine design on the Toronto Technical School staff. Mr. White has been engaged by a large firm in London, Eng., to install and operate a surveying plant, which he takes over with him from Hartford, Conn.

Jno. Hunter, brassfounder, Halifax, N.S., died last month. He was about 78 years of age and had spent about half a century in Halifax. For a good many years he carried on business on Sackville street, with his son Edward, but he first opened on Hollis street with Robert Wright as his partner. The deceased, who was a native of Glasgow, Scotland, was a citizen much respected by all classes, and his death will be deeply regretted.

George E. Drummond, of the Canada Iron Furnace Co., has returned from the old country, and one result of his trip is that considerable shipments of Canadian iron will be made to Great Britain and Germany. It is very gratifying to know that the superior qualities of Radnor Forges iron for special purposes are now acknowledged abroad as well as in Canada. Mr. Drummond confirms the reports that Canada now occupies a larger place in the mind and heart of Great Britain than it ever did before, and the next few years should see a large development in Anglo-Canadian trade.

The popularity of F. P. Brothers, late chief of construction of the Montreal Street Railway, was demonstrated shortly before he left for Jamaica, where he will superintend the building of a new line, by a banquet tendered him. The general manager, F. L. Wanklyn, presided, and covers were set for over a hundred, which included representatives from all the departments. The speech of the evening was made by Supt. McDonald, who, in the course of his remarks, said that he would use a strong and more electric expression concerning Mr. Brothers, by stating that their best affections had been permanently grounded by the magnetic currents of his well known business tact, his ability and genial friendship. The superintendent, amid great enthusiasm, then presented Mr. Brothers with a handsome traveling bag. Mr. Brothers, whose health was drunk with musical honors, received a great ovation. Short congratulatory speeches were also made by Messrs. Blackwale, president of the Canada Switch Co., J. Ross, Major Laurie, R. Chapman, John Garth, Landers, Carter and Swan.

Marine News.

Lunenburg, N.S., is to have a marine railway. The boiler, engine, etc., are now on the ground.

Thomas Gale & Sons, Cumberland Bay, N.S., are building a schooner 77 feet long. John Parker & Sons, of the same place, are also building a woodboat, keel 61 feet.

The British Columbia Iron Works, Vancouver, B.C., have contracted to deliver two river steamers for the Hudson Bay Company, one in March, and the second on April 15th.

The Albion Iron Works, Victoria, B.C., have contracts for machinery for a number of vessels, including those for steamers which the C.P.N. Co. will place on the Yukon and Stickeen rivers.

As it will cost $20,000 to repair the steamer "Rosedale," its owners have abandoned it to the underwriters, who will hand it over to the Donnelly Wrecking Co., in payment for the work of saving the boat.

The first of the officers of the new Richelieu and Ontario Navigation Company's steamer "Toronto," has been appointed in the person of William Black, chief engineer of the steamer "Hamilton," who is to be chief engineer of the new boat.

The Polson Iron Works Company is preparing plans for a yacht for Timothy Eaton, Toronto. The boat will be 55 feet long by 8 feet beam, 3 feet 6 inches draught, and will run 16 miles an hour. It will have a steel frame and wood planking, and a triple expansion engine and tubular boiler. The yacht will be the handsomest boat on the Muskoka lakes.

Warren McCurdy, of St. Andrew's, N.B. has invented an electrical log. It is claimed to be accurate, not varying three-tenths between different trips recorded by it from light to light. The rotary log, instead of turning the line as in ordinary taffrail logs, communicates by a little cable with the steamer and registers in the captain's room. There can be dials, worked from the same log, in any part of the steamer.

A public meeting in Goderich, Ont., recently passed resolutions in favor of running a line of first-class steamers the coming season from Windsor to Sault Ste Marie, calling at all the ports along the route.

Citizens of Annapolis, N.S., are forming a company to build a freight steamer to carry freight between Annapolis and St John, N.B., calling at Bridgetown, Granville Ferry, Clementsport, Bear River and Digby.

Col. Anderson, of the Marine Department, Ottawa, was in Parry Sound not long ago, and visited Depot Harbor and Kilbear Point to inspect the locality for the Department with a view of building a new lighthouse at Kilbear, and range lights west of Kilbear and Depot Bay.

We have received a nicely got-up catalogue of boats fittings and appurtenances, to be had of the builder, Harold B. Rye, of Peterboro, Ont. He is perfectly familiar with all the details in the construction of a great variety of small boats, including family, pleasure and fishing skiffs; paddling, cruising and racing canoes; cat boats, etc. Those who are interested in the subject of prospecting canoes will do well to consult this catalogue, which gives the prices of many different styles.

The J. Bruce Hanly Engine Works, Midland, Ont., are building a 7 x 14 x 10-inch steeple compound engine for the Muskoka Navigation Company, Gravenhurst, and a 13 x 26 x 20-inch compound engine for James Playfair and Capt. Burke, who are themselves building the hull here for a general purpose tug. They are also overhauling a 18 x 36 x 32-inch steeple compound engine, re-boring cylinders, putting in new pistons, valve rods, etc., besides new brasses throughout. This is for the James Playfair Company, which is building the hull in their Midland shipyard, and intend her for open lake log towing.

Charles W. Ross, of the Railways and Canals Department, Ottawa, has secured a relic of some interest. It is a section of the mitre sill of an old canal lock built in 1780 by the Hudson Bay Company. The oak timber has therefore been for considerably over a hundred years under water, and yet is firm and solid. The section has not been touched by worms. The canal, which was half a mile in length, was built by the Hudson Bay Company to get past the Cascade Rapids in the St. Lawrence, but long since fell into disuse. It has a raise of about 13 feet, and contains three locks. The construction work was done by Col. Colter Mann.

Application will be made to the Parliament of Canada, at its next session, for an act to incorporate the Lake Superior and Rocky Mountains Navigation Company, to construct canals, from Lake Superior near Thunder Bay, thence following a chain of lakes and rivers across the height of land to Rainy Lake, and by way of Rainy River to the Lake of the Woods; from the Lake of the Woods along Rousseau River to the Red River; thence along Red River, Assiniboine River, Lake Manitoba and Lake Winnipegosis to Cedar Lake on the Saskatchewan River; or in the alternative from the Lake of the Woods by way of Winnipeg River, Lake Winnipeg and the Saskatchewan to the last mentioned point; and from Cedar Lake on the Saskatchewan River and Bow River to Calgary, in Alberta, and along its northern branch to Edmonton.

F. M. Rattenbury and others have given the contract to J. Stephens, of the Clyde shipyard, Victoria, B.C., for three new stern-wheeled steamers to ply on Lake Bennett. These vessels are to be ready for shipment north within thirty days. All three vessels will be stern-wheelers, 80 feet long, of 16 feet beam and will have a draught of 18 inches when laden. They will be wooden boats and the machinery will be supplied by the Albion Iron Works. The contract for taking the hulls of the vessels into the lake will be distinct from that of either the furnishing of the machinery or the building of the hulls. A fourth steamer to be built at the Clyde yard will be a twin screw which J. Stephens has the contract from a Tacoma firm for constructing. It is intended for Teslin Lake.

A settlement has been effected between the parties in the suit of the Toronto Ferry Company for an injunction to restrain the city of Toronto from improving and maintaining the embankment protecting the intake pipe across the bay. This embankment caused stagnant water to accumulate in front of the Ferry Company's property and greatly depreciated it. By agreement the northern boundary of the Ferry Company's property is to be extended by means of piling to the conduit embankment opposite. The waterworks breakwater is to be extended southerly to the Ferry Company's property, and the area thus enclosed is to be filled in by the city with the sand pump. The city must undergo the expense of the piling, but the company must allow the city to use such piles on the eastern side of its property as become unnecessary by the proposed changes. The land thus made is to be used by the company in connection with their summer resort free of charges until the lease expires in the spring of 1901, when a renewal rent on a valuation basis shall be paid by the company. The company

on their part abandon all claims against the city for the silting up of their boat channel to the Point. They also forego all claims for past damages of any nature and consent to the issue of the order applied for to the Dominion Government, giving the city legal right to maintain the present embankment. Each party to the suit must sustain their own costs.

THE "Castilian," now building for H. & A. Allan, which will take her place on the Liverpool-Montreal route next spring, will have a registered tonnage of 8,800; her length will be 520 feet, and her beam 58 feet. She will have a speed of about fourteen and a half knots per hour, and passenger accommodation for 150 first cabin, 120 second cabin, and 800 steerage. The saloon, state rooms, and smoking room will be all located on the spar deck. The music room, which will be located on the bridge deck, will afford accommodation for a large number of passengers. The smoking room is arranged with easy chairs, divans and small tables for card parties. Besides her passenger accommodation, the "Castilian" will carry a large amount of freight. The freight accommodation will include refrigerators for perishable goods, and will be arranged so as to give different temperatures in the separate chambers.

Railway Matters.

THE T., H. & B. have given the contract for repairing their rolling stock to the Waterous Company, Brantford, Ont.

APPLICATION is made to the Dominion Parliament for a charter for a railway from Hull, Que., or Montreal to Rupert Bay.

THE C.P.R. has closed a contract for fifteen compound locomotives. They will be heavy and of the most modern design.

H. R. RIDOUT & Co., railway supplies, Montreal, have dissolved partnership, and a new firm has registered, composed of Edward H. Seale.

W. RUSSELL & Co. have been given the work of building the Pembroke Southern Railway from Pembroke, Ont, to Golden Lake, where it makes connection with the O.A. & P.S.R.

A DEPUTATION consisting of Hon. R. R. Dobell, J. G. Scott and others waited on the Local Government recently, asking a charter to build a railway from Roberval to St. James' Bay, a distance of 300 miles, through a very rich country of the Lake St. John district. The assistance they ask is a grant of land.

A BILL to incorporate the Niagara Tramway Company, with a capital stock of $50,000, has been introduced in the Assembly of the State of New York. It is the intention of the company to string a wire across Niagara Falls and run a tramway from one side of the river to the other. It is designed to carry passengers and freight.

GEORGE GOODERHAM, W. R. Brock, Robert Davies, Hon. L. M. Jones and J. Herbert Mason, are members of the committee of disinterested and public-spirited citizens whom Mayor Shaw, of Toronto, acting upon the suggestion in the letter of T. G. Blackstock to *The World*, has induced to consent to handle the question of the city building a railway from Toronto to James' Bay. The question whether the present lines of the C.P.R. or the G.T.R. are to be utilized, or an entirely new line built, is the most important one the commission has to decide.

A DEPUTATION, representing the Commonwealth Mining Company, consisting of S. O. Shorey, J. C. Holden, Senator Thibaudeau, Montreal; J. R. Barber, Georgetown, Ont.; C. Riordon, Toronto; J. B. Powell, Nelson, B C., and others, waited on the Dominion Government recently. The company has a scheme for a stage line between Edmonton and Dawson City, in the Yukon, which they say can be traveled in about twelve days. The distance is about 1,500 miles. They propose to construct a trail all the way from Edmonton, and ask the Government to guarantee interest on bonds to the extent of $2,000 per mile for 1,500 miles.

THE Restigouche & Western Railway has completed arrangements for building the first 20 miles of the line. Malcolm & Ross are the contractors, and C. L. B. Miles is chief engineer. The road will be from the I.C.R., at Campbellton, N B., to the St. John River at Grand Falls or St. Leonards, at either of which it connects with the C.P.R.; at St. Leonards also with the Bangor & Aristook Railway. By bridging the Restigouche at Campbellton, it will connect with the Atlantic & Lake Superior to Gaspe. There will be 110 miles to build, through heavy timber, sprnce and cedar, in abundance, and some fine tracts of farm lands, on ridges covered now by a wealth of rock maple.

THE Canadian Pacific Railway and Auguste Heinze have come to terms, and the agreement is that the Trail smelter, the railway from Robson to Trail, the short line from Trail to Rossland, and the lands received from the British Columbia Government as subsidies, are handed over to the Canadian Pacific Railway for the sum of $800,000 The narrow gauge from Rossland to Trail will at once be widened to the standard by the new owners, who will also make the grades much easier. The line from Robson to Trail is a standard gauge, is well built, and can be operated at once in connection with the system to which it now belongs.

THE Ontario Government voted the following railway bonuses at the last session: To the Ontario and Rainy River Railway, from a point at the westerly end of the 165 miles heretofore aided to a point at or near Fort Frances, a distance not exceeding 40 miles, a cash subsidy of $3,000 a mile—$120,000. To the Pembroke Southern Railway, between Pembroke and Golden Lake, from a point in the north-east part of the township of Alice to the north-eastern boundary of the said township, a distance of 3½ miles, a cash subsidy of $3,000 a mile—$10,000. To the Irondale, Bancroft and Ottawa Railway, from a point 45 miles from Irondale, at the end of the portion of the railway to which aid was granted in 1896, and thence due east for a distance of 10 miles, a cash subsidy of $3,000 a mile—$30,000. To the Bay of Quinte Railway, for such extension or branches of its projected and authorized line of railway north of the village of Tweed, as will not exceed thirty miles in all, and will enable the said company to connect its existing railway with the iron ore deposits lying northward of the said village of Tweed, in renewal of the amount granted to the Kingston, Napanee and Western Railway in the year 1893, a cash subsidy of $3,000 a mile—$90,000. To the James' Bay Railway, to aid in the construction of ninety miles of the said railway from Parry Sound to a point at or near Sudbury, $3,000 a mile for a distance not exceeding 40 miles ($120,000), and the unearned subsidy of $3,000 a mile for a distance not exceeding 50 miles, which was granted to the Nipissing and James' Bay Railway in 1889, which said unearned subsidy is hereby transferred to the James Bay Railway. (New vote, $120,000; transferred from other road, $150,000)—$270,000.

Mining Matters.

ACTIVE operations are going on at present in the Darling iron mine, Lanark County, Ont. Five thousand tons have already been taken out.

J. H. S. CASS, who is well known to the asbestos trade, is now carrying on business as the Cass Asbestos Mining Co., 97 St. James street, Montreal.

HALIFAX, N.S., papers have recently contained references to the reputed discovery of rich gold fields in Labrador. Some are said to rival the Klondyke in richness, but the reports are without confirmation.

AT a preliminary meeting of the B. C. Association of Mining Engineers, held in A. H. Holdich's office, Rossland, a month ago, a paper on mining laws by G. F. Moncklon, Esq., of Vancouver, was read and discussed.

A NEW oil field promises to be opened at Point Edward, Ont. A test well has been put down, and oil struck at a depth of five hundred and forty-five feet. A company has been formed, and they intend sinking more wells at once.

THE negotiations between Sir William Van Horne and T. G. Shaughnessey, of the C.P.R., and Heinze and Warfield in reference to the purchase by the C.P.R. of Aug. Heinze's railway and smelter in Kootenay, have been practically concluded, and it can be stated that the property in question has been transferred to the C.P.R. interest.

ARCHIBALD BLUE, Ontario Department of Mines, was recently interviewed by Messrs. Ashworth and Murray, of Sault Ste. Marie. They took up a claim in the Michipicoten district, and sunk a fifty-foot shaft. They report having struck a vein eight feet wide and nine feet deep, at a depth of fifty feet, which assayed $32 to the ton.

Two gold bricks from the Saw Bill mine have been on exhibition at Port Arthur, Ontario, recently. Their combined weight is 13½ lbs, and they are the result of 20 days running of the mill, crushing an average of 20 tons per day. Manager Wiley says that putting in a 20-stamp mill will double the output of the mine, and only requires the services of half a dozen more men.

THE following have organized the Northern Yukon-Klondyke Mining Company, Limited: Hon. G. Bryson, jr., Fort Coulonge, Que.; J Gillies, D. Gillies, M.P.P., Carleton Place, Ont.; W. Gillies, of the said place; J B. Fraser, Ottawa; J. B. MacLaren, Buckingham, Que.; A. MacLaren, Buckingham; J. C. Cox, Liverpool, Eng.; J. H. Francis and G. F. Francis, Pakenham, Ont.; J. W. Bryson, Fort Coulonge; W. H. A. Fraser, Westmeath, Ont.; H. Aylen, Ottawa; J. G. MacLaren, Ottawa; J. E. H. Barnet, Renfrew, Ont.

Wm Blackmore, chief manager of the Crow's Nest Pass Coal Co., was in Montreal recently, and will leave for the scene of the company's operations at Coal Creek. Mr. Blackmore has visited the leading mining centres in Canada and the United States, and with the result that the most improved electric coal cutting machinery will be started in the Pass mines. Orders for machinery have already been given out in Montreal, Toronto and elsewhere to the value of $100,000, while the company will erect about fifty beehive cooking ovens at Coal Creek for the purpose of supplying the article to the proposed smelter at Robson, B.C.

H. L. Simmons has purchased twenty acres near Nakusp, B.C., for a smelter site, and has also secured the water rights in that vicinity for the use of the proposed smelter. It will, it is said, be a plant similar in some respects to the one at Trail. It is thought at Nakusp that Mr. Simmons is connected with the parties who are about to erect a smelter at Vancouver. This company, it is claimed, intends to erect smelters at several points in the Kootenay country, and to send the product of these plants to the central refinery, at Vancouver, for separation into the several metals that are in the matte.

The following papers and subjects were presented and discussed at the meeting of the British Columbia Association of Mining Engineers, held in Badminton Hotel, Vancouver, a short time ago: "Notes on Mining Law and its Application to Mines and Mining Districts," by Frank C. Loring, M.E., Rossland; "The Possibilities of Smelting in British Columbia," by Robert R. Hedley, Nelson; "Notes on Southwest Kootenay Ore Bodies," by J. C. Gwillim, B.A. Sc., M.E., Slocan City; "Odd Notes on Mining," by A. H. Holdich, Nelson; "Mining Machinery in the Slocan," by Howard West, A.R.S.M., New Denver.

A shareholder of the famous Le Roi mine received a letter from Rossland recently containing the following details regarding that great property: The mine continues to ship about 200 tons of ore per day to the Northport smelter. Recent returns show that the ore is going about 1.54 ounces in gold, 4 per cent. copper, and 3 ounces of silver; its monetary value being itemized as follows: Gold, 1.54 ounces at $20, or equal to $30.80; silver, 3 ounces at 57 cents, equal to $1.71; copper, 4 per cent. (80 lbs.)at 10¾ cents, equal to $8.60, or a total of $41.11. Estimating the product of the mine at 200 tons per day, the gross value of the ore raised daily is $8,222, or $246,000 per month, which in turn makes the gross yearly product of Le Roi mine $2,959,920.

Reserve—Cassiar District.—Notice is hereby given that the under-mentioned tracts of land are reserved for Government purposes until further notice, viz.: 1. A belt of land, five miles in width, extending back from the shore line of the whole of that portion of Bennett Lake which lies within the province. 2. A belt of land, five miles in width, extending back from the shore line of the whole of that portion of Teslin Lake which lies within the province. 3. A belt of land commencing at a point five miles below Glenora, on the Stikine River; thence up the said river to a point five miles above Telegraph Creek, and having a width of five miles on each side of the said river. —Geo. B. Martin, Chief Commissioner of Lands and Works for the Province of British Columbia.

At a meeting of the Peninsula Mining and Development Company, Limited, held at Windsor, Ont., Jan. 15th, all arrangements were made by the company for their expedition to the Klondyke, which will leave Windsor on February 15th, under the management of Major J. E. Johnson, of Leamington, Ont. The following gentlemen will accompany the Major: C. A. Hugheson, Ouvery; J. C. Burk, Blenheim; M. Toll, Ouvery; J. Coyne, Leamington; B. Noble, Leamington; D. Noble, Northridge; William Johnson, Essex; J. Lickman, Essex; J. C. Myres, Cottam; C. McApe, Cottam; J. Imeson, Wheatley; R. F. Leeming, Kingsville; D. Edwards, Coatsworth; F. Dawson, Coatsworth; Thomas Dancey, Coatsworth; W. Toll, George Lawrence, J. B. Lawrence, Blenheim. The expedition will go by Edmonton, and expects to reach the Yukon district in about two months.

An incident of great interest to the mining district of North Hastings, Ont., took place lately at the Belmont mine, near Marmora, Ont., now being operated by the Cordova Exploration Company, Limited, of Newcastle-on-Tyne, England, which was the official opening of the company's new stamp mill by Miss Grace Carscallen, daughter of A. W. Carscallen, M.P., who formerly owned and developed the property. The opening took place in the presence of a number of persons who had been invited by the general manager, David G. Kerr, Glasgow, Scotland, late superintendent of one of the mines of the same company in Norway, who came to take charge of the property on the 15th of August last. The mill was erected and the machinery built and put in place by the Wm. Hamilton Mfg. Co., Limited, of Peterboro, and speaks well for this firm, who are so widely and favorably known throughout the Dominion as mining machinery manufacturers The construction was under the supervision of Richard Proutt, of Marmora. After the ceremony of opening and inspection was over, and after visiting the Assay Office, which is in charge of George Hardy, chemist, of Newcastle-on-Tyne, a young employee of the Cordova Exploration Company, the party were entertained to a sumptuous repast at the manager's residence.

THE ONTARIO RE-FORESTING COMMISSION.

During the recent session of the Ontario Legislature, the Commissioner of Crown Lands laid on the table the report of the Royal Commission appointed in June last to investigate the subject of "restoring and preserving the growth of white pine upon lands in the Province, which have been cleared or partially cleared by lumbering operations or by fire, and which are not adapted for agricultural purposes or for settlement." The commission consisted of E. W Rathbun, president of the Rathbun Lumber Co.; John Bertram, president of the Collins Inlet Lumber Co.; J. B. McWilliams, superintendent of Forest Rangers; Alex. Kirkwood, of the Ontario Crown Lands Department and Thomas Southworth, Clerk of Forestry.

During the fall and summer the members of the commission visited the townships of Smith, Harvey, Galway and Burleigh, in the county of Peterboro; the territory along the north shore of Lake Nipissing, and down the Vermilion River, in the township of Louise; the country around Thessalon, Algoma Mills and Killarney; the townships of Carlyle and Humboldt, and other points on the north shore of Georgian Bay and in the neighborhood of Georgian Bay. The commissioners also inspected some of the territory on the north shore of Lake Superior and the country along the line of the Port Arthur, Duluth & Western Railway west of Port Arthur, in addition to taking a somewhat extensive trip through the Rainy River country, visiting also portions of the northern parts of Minnesota and Michigan in the United States.

Though the commission has not yet had time to examine minutely enough into local conditions to be able to submit detailed plans for the care and management of the areas visited, yet its investigations have been of a sufficiently technical nature to warrant them in coming to the conclusion that with sufficient areas set aside for the purpose, and with reasonable care and protection of the young and growing timber now upon them, the supply of merchantable timber in the Province of Ontario will be vastly augmented. The commissioners next score lumbermen for the reckless maner in which they have treated our forests. The former apparently limitless forest wealth of the province has led them to be incautious as to the safety of the forests, and the litter they have left lying about has fed the destructive fires that have always followed. These fires have destroyed the original growth, and in many cases paved the way for the springing up of a crop of other varieties more easily propagated. It has been found, however, that where any of the original trees survived the fire and produced seeds, the forest has eventually assumed the characteristics of the growth indigenous to the locality. The widely-entertained theory that the white pine on being cut away is invariably and permanently succeeded by a crop of inferior varieties, was completely disproved by the frequent instances observed in which tracts of flourishing young pine trees are growing up on cut-over land, and the prevalence of the idea can only be accounted for on the ground that fire has in so many cases completely exterminated the pine in all stages of growth. There seems to be no doubt that with the exclusion of fire, and the adoption of more intelligent and provident methods of lumbering, there would be no difficulty in securing a quick and sure production of the varieties of trees desired.

As a rule, after the fires the seeds of the aspen, poplar, birches and cotton woods, which are carried great distances by the wind, soon cover the burned-over area, and a vigorous crop of these varieties springs up, and speedily occupies the ground. In most cases, however, a few pines have managed to survive the fire, and where this is the case their seeds are scattered and soon supplant the poplars and other inferior growths. In looking casually over one of these devastated tracts, the first impression conveyed is that poplar and other deciduous trees form the sole vegetation, but a closer inspection will reveal the presence of a large stock of young conifers, which in time will outgrow and drive the poplars into decadence. The commissioners put forward as an example of what results might be obtained, the township of Burleigh, in the county of Peterboro. The cutting of timber began here 50 years ago, the original forest being chiefly of excellent pine. About 33 years ago a colonization road was run through the township, and since then the lumbermen and the fires started by settlers have devastated the forest on the west side of a stream known as Eel's Creek. The frequent fires have burned over a large part of the soil and killed any pines that may have been left by the lumbermen, so that any national reforestation would be a very slow process.

Now, for the other picture. The east side of Eel's Creek presents an altogether different aspect. Viewed from the Burleigh road, it has the appearance of a thrifty young poplar forest, with a few young pine trees appearing on a level with the poplar. On closer examination, it was found that the young forest was largely composed of red and white pine. It was moreover learned that this portion of the forest had not been visited by fire since twenty-three years ago. The pines will, if protected from fire, soon overtop the poplars and assert the supremacy of their species. The conclusion arrived at was that within fifty years lumbering operations in this locality could be profitably resumed and the larger pine trees taken out, producing timber of a merchantable quality, and giving the younger trees a better chance to grow. Reasonably good forest conditions could, under proper regulations for cutting, be introduced and a continuous supply kept up. This statement as to the condition in the township of Burleigh may be taken as fairly typical of the course of natural forest regeneration in nearly all the fire-swept lands which came under the observance of the commissioners. Much of the forest lands now looked upon as of little use will yet, under proper protection, be very productive. The main feature of forest preservation must be protection from fire.

To the north of the height of land which sheds water into Hudson Bay, it was found that some timber lands had been burned over through the carelessness of Indians, but the Hudson Bay officials there had promised to help the Government in protecting the forests. The commissioners proceed to say that, though in earlier years the lumbermen confined their operations to taking out trees which measured at least 14 inches diameter at the butt, many rafts were observed to-day to consist of mere poles--six inches or so in diameter. This practice should be promptly stopped by the Government.

The commissioners give the following idea of the rate of growth of white pine: A young tree which would cut only one log 8 inches in diameter and 16 feet long, measuring 16 feet, board measure, would, if allowed to stand for thirty years, grow in diameter at the rate of one inch in five years - in some cases the growth is an inch in two years—and hence would give a butt of 14 inches diameter, 16 feet long, or 100 feet of lumber, board measure. In addition to this, however, this tree would have grown in height sufficiently to give two more logs, one, say of 11-inch, and one of 8-inch diameter, both 16 feet long, or a total of 164 feet, board measure, for the tree. Thus, a tree that required, perhaps, 40 years to make its first 16 feet of merchantable timber would in 30 years more have increased to 164 feet.

The commission suggests that a market should be secured for the "thinnings," which should be taken out where the timber stands too thick, and the idea is put forward that much of this apparently useless forest material might be utilized in the manufacture of pulp and small wood goods, or for the production of charcoal for smelting ores.

In conclusion, the commissioner recommends that—

1. The present system of fire ranging inaugurated by the Government in 1886 be extended so as to be compulsory on all the holders of timber berths; that all unlicensed timber land contiguous thereto be also protected by rangers employed by the Government, and that all fire rangers be subjected to the inspection and control of the Department of Crown Lands.

2. That the officials of the Hudson Bay Company be asked to co-operate with the Government in preparing and printing fire proclamations in the language of the Indians of the northern districts, to be posted along the canoe routes throughout the country.

3. That for all unworked limits on which the ground rent shall be two years in default on the termination of the present license year, the license shall not be renewed, but the berths be held by the Crown as forest reserves.

4. That license-holders be not allowed to cut any trees for logs smaller than will measure 12 inches across the stump, two feet from the ground, unless under special forest conditions, with the sanction and under the supervision of the district forest ranger.

5. That the Government take power by Order-in-Council to withdraw from sale a location, and set aside, to be left in permanent Crown forest reserves, such areas of territory as are generally unsuitable for settlement, and yet valuable for growing timber.

FIRES OF THE MONTH.

Jan. 12th—North-West Elevator Co.'s elevator, Cypress River, Man.; partly insured. — Jan. 13th—The Dominion Paper Box Co.'s building, Adelaide street, Toronto; loss, $50,000. ——Jan. 17th—A. Merizzi's woolen mill, Napierville, Que., loss, $10,000.——Jan. 21st—Richelieu and Ontario Co.'s office, Montreal; damages, $800.——Jan. 23rd—The power house and car house of the Metropolitan Street Railway Co., Toronto; damages, $10,000; fully insured.——Feb. 1st—The Doherty organ factory, Clinton, Ont.; damages, $75,000, insurance, $35,000.

—J. H. Still promises to have the St. Thomas electric street railway in operation before Dominion Day.

—The voting on a $25,000 system of waterworks for Mount Forest, Ont., took place January 20th, and resulted in the by-law being sustained by a majority of 49.

—The trustees of Havergal Ladies' College, Toronto, have taken out a permit for the erection of a three-story brick school building at 356 Jarvis street, to cost $35,000.

—Edward Hooper, Toronto, has taken out a permit for the erection of a five-story brick addition to the Grand Union Hotel at the corner of Front and Simcoe streets, Toronto, to cost $30,000.

—The Ontario Wind Engine and Pump Company has taken out a permit to erect a two-story brick machine shop and office at the south-west corner of Atlantic avenue and Liberty street, Toronto, to cost $3,000.

—It is stated upon good authority that the H., G. & B. electric railway will be run through to St. Catharines if the Decew Falls power scheme proves a success, so that the company can get power from that source.

—In view of the Canadian Pacific's decision to bring Toronto business round by Carleton Place a large number of new locomotives will be put into service on the line, orders for some forty new engines being now in the hands of locomotive builders.

—The Polson Iron Works Company, Toronto, has secured the contract from an English syndicate for the building of a steamer to be used on the Yukon River. She will be a stern-wheeler, dimensions 45 feet long and 9 feet beam, and will draw only 15 inches of water.

—The Ontario Government granted the sum of $35,000 towards the construction of an International railway bridge across the river St. Lawrence, at Cornwall, on the line of the Ottawa and New York Railway; provided that aid be granted also by the Government of Canada.

—A big scheme is on hand for the incorporation of the Montreal and Champlain Canal Co., which proposes to construct a canal from the St. Lawrence to the Richelieu River, a distance of 18 miles. The company is to have a capital of $6,000,000. Albert J. Corriveau is the promoter.

—There was a general strike of men employed by the Canadian Pacific Navigation steamers in British Columbia, February 2nd. They demanded an increase in wages in view of the rush to the Klondyke. Some of the strikers were placed under arrest charged with violating the laws governing the sailing of vessels. They appeared before the magistrate, who gave them the choice of going to work or jail. They chose the former.

—The annual report has been issued of the Niagara Falls Park & River Railway. The report shows the number of passengers carried is away ahead of previous years. In 1896 the passengers carried numbered 497,000; in 1897 the number carried was 579,000, giving to the year 1897 an increase of 82,363 passengers over 1896. The Niagara Falls Park & River Railway was established in 1893, and has been a success ever since its inception. W. Phillips, who has completed his first year as acting manager of the road, was appointed general manager at an increased salary.

—The second inter-provincial conference of Canadian mining engineers and mine managers will be held in Montreal, under the auspices of the Federated Canadian Mining Institute, commencing Tuesday, March 1, and continuing the three following days. Some forty papers will be read and discussed by the members of the association. The proceedings of the conference, which will take place in the ladies' ordinary and other rooms of the Windsor Hotel, will be open to the public. The annual banquet of the association will be held at the Windsor Hotel on the evening of Thursday, March 3rd.

—Although little or nothing has been said about it, the Chateauguay and Northern, or, as it is better known, the Bout de l'Ile Electric Railway Company, has done a very considerable amount of construction work during the season past. The system has been connected with the Canadian Pacific Railway freight yards, on Moreau street, Montreal, the meeting of the two roads being effected near the old North Shore freight office. This new branch, which brings the Chateauguay and Northern into immediate connection with the C.P.R., embraces about 1½ miles of track, the rails being 60 lbs. to the yard, and extending all the way from Lasalle street to the Canadian Pacific yards, just mentioned, so that goods can now be billed from any part of the C.P.R. to any point on the electric road in question.

THE KNAPP ROLLER BOAT.

Editor CANADIAN ENGINEER :

SIR,—Now that the Knapp boat is laid up for the winter without a speed trial, it may be of interest to consider some of the points which have been made against her success. Foremost among these is the great wind question. It is claimed that wind pressure reduces the speed of the " Campania " from 560 to 180 knots a day. Is this the whole truth? I think not. A vessel of that class is submerged about 33 feet, or nearly two-thirds of her entire bulk. The air, through which the smaller portion of the vessel has to make its way, is some 700 times lighter than the water which resists the submerged portion. But the water in a high head or quarter wind acquires under the influence of the wind, a very rapid motion. This rapidly-moving water, weighing hundreds of tons, is hurled against the bows of the on-coming vessel. A vastly lighter body of air is at the same time opposing her upper works. But which has the greater effect in reducing her speed? Obviously 700 tons of water will retard her speed more than one ton of air. It is probable, may we not say certain, then, that the " Campania's" speed is reduced, not by the wind pressure on her upper works, but by the resistance of the rapidly-moving water against the submerged portion of her hull. The wind pressure in itself can add but very little to the retardation.

Now, discarding all other elements but those of water resistance, how will this affect the full-sized Knapp boat? To begin with, the immersion will be considerably less than one-half that of the "Campania." The serious resistance will therefore be diminished in that proportion. But this is not all advantage to the Knapp boat. The trials have shown that increase of water resistance produces increase of speed, thus completely reversing present conditions. The weight of water flung against the submerged portion, which is curving downwards and away from the on-coming wave, will tend to "sweep her legs from under her," just as a beam sea causes the staunchest boat to roll. But to roll is just what Mr. Knapp's boat is built to do. Consequently this terrible foe of present-day craft will be an actual friend to the new monster.

But how about the wind on the upper works? Here, indeed, there is a tremendous increase of surface to play upon. But here also another principle appears which may very possibly surprise the cock-sure prophets. If two moving bodies meet, the lighter of the two will be inevitably overcome by the heavier. Now the Knapp boat will weigh some 15,000 tons, and will present 112,500 square feet to the wind, less the submerged portion. Now in calm weather, at a speed of a mile a minute, the heaviest pressure of wind would be about 18 lbs. to the square foot, or, adding the resistance of a 40-mile gale, about 26 lbs. to the square foot. The weight of wind to be encountered would thus be about 1,012 tons in calm weather, or 1,462 tons in a 40-mile gale. What will happen to that 1,462 tons when 15,000 tons are thrown forcibly against it at the rate of a mile a minute? Which must give way? I imagine there can be no two answers to this problem.

But very competent engineers think that the surface presented to the wind would be more accurately represented by multiplying the length by one-half the diameter, for the reason that the shape of the boat and its peculiar motion would greatly reduce the retarding effect of the wind upon it. If this be admitted, the pressures given above must be divided by two, giving 506 tons wind resistance in calm weather, or 731 tons in a 40-mile gale, and with the boat going at a mile a minute. It will be seen, therefore, that everything against the boat is conceded in the above argument, while in what I am about to say I shall concede everything in favor of my examples.

It will doubtless be objected that the horse-power necessary to drive that 15,000 tons against 1,462 tons at the rate of 5,280 feet a minute will be so enormous that the boat could never carry it. To this the inventor replies that the momentum of his boat will be in itself sufficient to overcome wind resistance, and all his engines need do is to roll his boat *in* the water at that speed. The weight of the boat and the aid of the resisting water will do the rest. But we are told "there is nothing in momentum." Fortunately that fact can be tested, because ships are not the only moving bodies which are confronted with wind resistance. Let us take then as a test the Holman engine, which recently ran at the rate of a mile in 28 seconds for a short distance, and made the whole mile in 32 seconds, or the Empire State express, which has a record of 34 seconds for a mile. It is noticeable in both cases that a long run was made first, in order to "get up speed;" in other words, to acquire momentum. The Empire State express traveled 17 miles for this purpose; the Holman engine, 3 miles. Both present approximately 120 square feet of area when driving directly against the wind. If the wind is slightly on the quarter, this area would be much increased. But let us take the smallest area for our purpose. Taking the speed at two miles an hour the wind pressure would be 4 1-3 tons upon the square surface area of the train, head on. Reduced to horse-power, this would be roughly 3,000 h.p. But the engine actually possesses only about 1,500 h.p., and this is mainly used in overcoming the mechanical resistance of the inertia of the train, and all the friction of the machinery. Here, then, is a problem for objectors. It is evident that power is required merely to move the train. It is also evident that the engine does not possess sufficient horse-power to overcome the wind resistance alone, as ordinarily calculated. Whence then does the power come that not only moves the train, but overcomes the wind pressure also, and speeds along at a rate of a little under or over two miles a minute? Mr. Knapp says it is gained from the momentum. The engineers say there is nothing in momentum, but they do not answer this curious problem. Until they can it is at least possible, perhaps even probable, that Mr. Knapp is right. What you say in your July number as to the limitation of the effective power of the engines is admitted by Mr. Knapp to be true, and he has all along objected that this was a wasteful mode of applying the power. He wishes to apply it direct to the axle by the action of cranks.

I may add that I know the inventor well, and have constantly discussed the boat with him for the last three years. I do not wish him to be held responsible, however, for anything I have said except when it is directly attributed to him.

ONE OF THOSE INTERESTED.

Kingston, Dec., 1897.

NOTE.—The writer of the above letter has, in starting out, evidently confused wave motion with current. If he goes out on Lake Ontario after a storm, when a dead swell is on, and drops a stick on the water, he will find that though the waves heave ever so high the stick does not move away, but swings back and forward with each undulation. Even in a gale the surface water blown along by the wind is only a shallow "skim," and never keeps pace with the undulations of the waves. All the arguments built on this misconception fall to the ground, and need not be discussed. The writer asks, "What will become of that 1,462 tons (wind pressure) when 15,000 tons (weight of boat) are thrown against it?" One might answer that question by asking what will become of the roller boat when, with motive power limited to the slight leverage obtained by the weight of the internal machinery, it is exposed with its 112,500 square feet of surface to a howling gale? Our correspondent talks of the momentum of his boat overcoming the wind resistance, but how will he get his momentum without power? And power he has not got, and cannot get a boat on this plan. He is equally wrong in his speculations on the speed of a railway train. It is power, and not momentum, that enables a train to get into motion on an up-grade against a gale of wind. A gentleman of wide experience and good judgment, both on marine and mechanical questions, and who has studied Mr. Knapp's boat, is of opinion that three to six miles per hour is all she is capable of even in a comparative calm. With regard to the arguments used by "One of those Interested," he says:

" The supposition that the movement of the water against the direction of the vessel would help it to go ahead is absurd. The current of a river would be analogous to such a movement of water (if it existed). Therefore, if the Knapp boat was rolling up a river, the more rapid the river the faster the boat would run up it! The certainty is that the same law would hold good as in the case of any vessel. The speed up the river along the land would be the ordinary speed of the boat in calm water, minus the miles per hour of the current against it. The illustration is given of a beam sea causing a boat to roll. But a beam sea rolls the boat away from the wave, not towards it. With reference to the action of wind on the upper works, the proposition is made that if two moving

bodies meet, the lighter will be overcome by the heavier. Quite so, but the speed of the heavier will be diminished in proportion to the weight of the lighter. Therefore, the heavier the wind the slower the boat working against it, and, of course, the larger the surface acted upon the greater the retardation. The error here is on assuming that the weight of the boat (15,000 tons) is any factor. It is not the weight of the boat versus the wind, but the power of the engines, whatever that may be, versus the power of the wind, with the uneven surface to act upon. But the success of the new departure must be judged by results. Taking the power put into the boat, the manner of its application, and the resistance of the peculiar form of the hull into consideration, it was estimated by experts and practical men that the speed in still water would be about four miles per hour. This at the experimental trials proved to be the limit, thus demonstrating the accuracy of the calculations. The same power on a similar displacement with a scientifically-shaped hull would have developed about 15 miles at least. But supposing a reasonable amount of speed had been obtained, what then? The monstrosity is incapable of fulfilling any one of the ordinary requirements of navigation. There can be no accommodation for passengers. It would be impossible to carry cargo in such a shape that it would not be ground to powder as it was rolled around. The vessel could not be brought to an anchor, if it became necessary. In fact a more utterly unpractical form of ship could not be devised, even if the inventor had had that in view as the sole object of his labors.

A contingency that the inventor cannot have considered as he talks of a mile a minute, and that is that at this speed, allowing 20 per cent. slip, the 20-foot hull would have to revolve 100 revolutions per minute, at which speed the centrifugal force would send the cargo through the ship's bottom, and if not accurately balanced, would shake the vessel to pieces.

In an interview with one of the Toronto papers, Mr. Knapp said he would not attempt to steam against a gale, but as winds move in cyclones where diameter is never more than 400 miles, he would just roll out of the boundary of one of these cyclones, and then go on. R. F. Stupart, Director of the Meteorological Service, has some knowledge of the character and extent of cyclonic movements of wind, and in reply to an enquiry on this matter, Mr. Stupart says: "It sometimes happens that severe tropical cyclones are not more than 400 miles in diameter, and sometimes considerably less; it is seldom, however, that the storms occurring on the trans-Atlantic and Pacific routes are less than 1,000 miles in diameter, and frequently they are much more. A southerly gale in advance of a storm centre will oftentimes begin to blow near the coast of Ireland, while in the rear of the same storm centre a north-westerly gale is still blowing off the coast of Newfoundland. As these storms do not progress eastward at a greater average rate than 30 miles per hour, it will doubtless be possible for the roller boat when it acquires a speed of *sixty miles per hour*, to keep out of the bad weather."

ELEVATORS, HYDRAULIC V. ELECTRIC.

Editor CANADIAN ENGINEER :

In your January issue, P. W. Moses, consulting electrical engineer, of New York, takes exception to some of the statements in the article on elevators in the December issue. I can not see where Mr. Moses proves my statements to be incorrect, and therefore it is difficult to answer him. Also he is an expert, and the article was written for an engineer like myself, and I feel flattered that it was of such moment that it was taken up by a New York electrical engineer, but as Mr. Moses has given his opinion, I will try to follow him, and simply repeat what I stated before, and what are practical facts.

In the first place, I do know more about hydraulic than electrical elevators. I am as well acquainted with electrical elevators as I care to be, and I very likely know a great deal more about the generating end of the electrical plant than Mr. Moses does; not theoretically, but practically. It is easy to figure on any subject, but figures are not what we pay for: it is coal, oil, and repairs, with labor, interest, etc. Mr. Moses says that an engine and generator can be put in for $5,000. It can, but it is not enough, and will not purchase a plant large enough for five elevators, let alone a duplicate plant, whereas a first-class compound pumping engine can be put in in duplicate large enough for five elevators for the sum of $5,000, and if the architect put in an electric generating plant in keeping with the rest of the building, it would not be a one-horse show that could be purchased for $5,000. I know what it costs to install generating apparatus, also hydraulic elevators, and if the proper specifications were got out, and the manufacturers thought that they would get a fair show, the five elevators could be installed in a first-class manner with pumping machinery, for $30,000. The elevators, if electric, cannot run off the lighting engines satisfactorily; no matter what Mr. Moses thinks, it is very seldom done, except in very large stations or where they have only one elevator.

In the matter of safety, Mr. Moses proves just what I stated, namely, that the electric is more complicated, which does not tend to safety, but is dangerous, for the electric devices that you are depending on often fail to work when you want them, because the current is off. He says that there is not an elaborate cycle of changes during the time of starting, and then goes on to describe the very changes I spoke of. The electric man says that all you have to do is to push the button in the car and it starts, but just trace out all that occurs from the time the button was pushed until the car was at full speed. Then watch the hydraulic apparatus. You move the hand-wheel and it moves the valve direct. Nothing could be simpler, but the electric is simple enough to anyone looking through electric spectacles. Mr. Moses says that the electric elevator does not appear complicated. It does not appear so, but it is very complicated. Just the same in comparison with hydraulic. Even when he compares the electric elevator with the hod-hoist, which, by the way, I think is an apt comparison. He states that they are in use in hundreds of New York buildings, and receive the least possible care and attention. That may be one of the reasons that they run so badly: or they may get the least possible care, and yet, that least possible may mean a great deal of work. A gentleman went to New York to look into elevators before installing a large plant, and everywhere that they had hydraulic the practical men around the plant spoke well of them, and where they had been electric, almost invariably they were dissatisfied, and said, "put in hydraulic by all means."

Mr. Moses also says that the comparative wear and tear is yet to be determined. It may be by Mr. Moses, but I can cite cases in Montreal, Buffalo, and Toronto, where electric elevators cost more for worn out parts in the first six months than any hydraulic would in two years, and he acknowledges that the life is shorter for the generating apparatus, and as that generating apparatus costs more than three times what the same size pumping plant would cost, it does matter a great deal. I will not go into figures, as I can prove by figures that the electric is the more economic as far as coal is concerned, but I also know that it costs more for repairs on certain electric elevators than it costs for current, and when material and labor are taken into account, the economy is on the side of the hydraulic.

I again make the statement that the plant should be the full capacity of the five elevators, and my practical experience as engineer of the Incandescent Light Company proves that, and anything short would be folly. My experience there proved to me also that nearly all the complaints from customers were due to elevators coming on when the load was light, and the company has since put them all on a separate circuit, thereby improving the lighting system wonderfully. When the load is heavy, the elevator adds such a small percentage that the effect is not noticed That is why the New York companies can run the electric elevator with practically no effect, as their load is heavy all the time.

In conclusion, I know more about the condition of Toronto and its City Hall than Mr. Moses does, and I could prove even to Mr. Moses that hydraulic elevators is what the City Hall should have, if he were anything but an electrical engineer. One of the proofs in the previous article was, that all the manufacturers making both kinds of elevators says they should be hydraulic, and only one, who makes only electric elevators, says they should be electric, and of necessity electrical engineers would say the same. Mr. Moses knows more about electricity than I do, no doubt, but he very likely has not the knowledge that the practical side of the question gives by long experience.

Toronto, Jan. 25th, 1898. ED. PHILIP.

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. V.

ROADBED CONSTRUCTION.

ARTICLE 27.—FOUNDATIONS.

The foundation of a structure is much more important than any other feature of its design, as on its security depends that of the structure itself. We may therefore be justified in examining closely into the bearing power of soils, the various methods of increasing it or distributing the load over greater areas, and the various methods of sinking or making foundations.

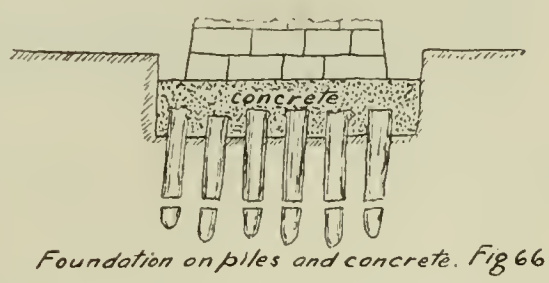
The bearing power of soils varies very much, being least for soft clays and unconfined quicksands, and increasing through sand, gravel, firm clay and hardpan to solid rock; it may be as low as one-half ton per square foot, and as high as 180 tons per square foot, but it is only with the lower values that we need deal. A good clay foundation will bear safely 2½ to 4 tons per square foot, and dry sand or gravel from 5 to 6 tons, while cases have been known of 10 to 11 tons per square foot being carried. In railway work 3 or 4 tons per square foot is usually all that we want to put on to a foundation; consequently, whenever good firm clay (which will not be watersoaked), sand or gravel are reached, the foundation may be considered safe, provided we have sounded several feet, and in case of important structures, many feet below the foundation bed, to see that the substrata are equally firm. Rankine's earthwork formula takes account of the depth of the foundation beneath the ground level, and one rule in use in the Western States is that the safe load per square foot on sand is 2 tons + 1 ton for each 10 feet in depth. No account has been taken of the friction of the soil on the sides of the structure below ground level. This is only of importance where the foundations are sunk by pneumatic caisson or open dredging, in which case it is variously estimated at from 200 to 600 pounds per square foot of surface exposed to side friction. If the caisson is of cast iron, about 300 lbs. for wrought iron, 900 lbs. for masonry, 300 to 600 lbs. for timber, and for piles 500 to 1,000 lbs. per square foot.

*This series of papers will be Issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

FOUNDATIONS ON LAND.

Where a firm foundation is obtainable within a few feet of the surface, all that is necessary is to dig a pit below frost level, or to any required depth and commence stonework at once, or often lay 1 or 2 feet of concrete to get a uniform bed to lay on, if the foundation is bouldery or uneven; but if, on the other hand, the foundation bed shows soft spots or uneven bearing power, the difficulty may be overcome by using a deep bed of concrete which will span over small spots (provided there is no danger of undermining by scour from an adjacent river, liable to change its channel), or by using a grillage of timber instead, in cases where the timber will always remain watersoaked, but not otherwise. Again, the same expedients may answer if the whole foundation is somewhat, but not very, soft, by spreading out over a larger area. When, however, it is found that the foundation is too soft for such methods even if thoroughly drained, and that it will not pay to dig down far enough to reach a firm one, recourse must be had to some artificial method of obtaining greater bearing power, the usual way being to drive piles, although in some cases where cost is no object or the piles would be subject to decay, large platforms formed of cross-layers of steel I beams or rails bedded in concrete (as in Chicago), have been used to great advantage, the transverse strength being such as to enable a very much enlarged area being used. When sufficient piles are driven to carry the load required they may be cut off level and capped by drift-bolting on a double layer of 12 inch by 12-inch timbers, as a base for stonework, or preferably either on the broomed heads of the piles or after sawing them off, a layer of concrete is placed and also rammed around and between the piles, in which case the earth between the piles will take a portion of the load, being much compacted by the driving, indeed, in cases where timber is scarce, a method has been adopted of pulling out piles after driving and immediately filling the holes with well rammed sand, the compacted earth and the sand pillars together carrying the load safely. Cast iron and

wrought iron screw piles are used extensively in ocean jetty, lighthouse, and pier construction, but for foundations to masonry structures on land the wooden pile is in



Foundation on piles and concrete. Fig 66

almost exclusive use; of the various ways of driving piles by steam hammer, drop hammer, water jet, gunpowder explosions or insistent weight, the first three are the only ones worth considering.

The water jet is used economically where water is plentiful, ordinary pile driving inconvenient, and in sandy, quicksandy or silty soils (indeed it is often the only means of driving piles in bad quicksands), the water is carried in a pipe down the side of the pile and is projected in large quantities and considerable pressure just below the point of the pile; this allows the pile, assisted by a dead weight or by light blows from a small hammer, to sink very rapidly, the water rising in a film around the surface of the pile and almost eliminating friction as long as the action continues, but after driving is finished the sand or earth settles around the pile and gives as high a bearing power as with hammer-driven piles.*

The Steam Hammer weighs from 4,000 to 5,000 lbs. and sits on the head of the pile, striking a blow with a piston loaded with about 3,000 lbs., the stroke is $2\frac{1}{2}$ to 3 feet in length and about once per second. This keeps the soil and pile in a continual vibration and effects more than the occasional, though more severe blow of a drop hammer. Although a steam hammer is unable to drive in very hard ground economically, and is not economical where only a few piles are to be driven in a place, as the cost of transportation of hammer, boiler, steam-pipes, etc. is too great, yet wherever a great many piles are to be driven in one locality, as on docks, large foundations, etc., or where the outfit can be economically transported from place to place, it can drive piles much more cheaply and quickly than a drop hammer.

The Drop Hammer is raised either by hand, horse, or steam power, and usually a trip is arranged to free the hammer automatically at the top, the line being brought down again by hand, which takes time. In order to avoid this, sometimes, in driving by steam, the line is permanently attached, and a friction drum is utilized to let it drop without tripping, thereby dragging the line with it and lessening the force of the blow, but economizing time. The chief danger in this method lies in its abuse by dishonest contractors, where the pile-driving is specified for certain maximum penetration at the last blow, in which case, a slight friction on the drum will materially lessen the effect of the blow. The weight of drop hammers varies from 1,200 to 2,000 lbs., and the drop from 15 to 30 feet depending on the hardness of driving and pile head, and length of leads. The drop and steam hammer are in general use, and the load which a pile can safely carry may be approximately estimated by various empyrical formulæ, when the drop, weight of hammer, and penetration at the last blow (with an unbroomed head to the pile) are known, such formulæ are usually on the safe side, because although at least one instance has been given of a pile refusing to drive at all, and yet after a day's rest going five or six inches, yet the usual experience is that piles which will penetrate several inches at a blow, after long continued driving, will penetrate less, or almost refuse to drive after a rest of a day or two allowing the material to settle around the pile.

*See *Engineering News*, Vol. 31, 1894, page 316, for jet pile driver.

The three formulæ looked upon most favorably in America are:—

(*a*) Weisbach's or Sanders—

$$\text{Safe load} = L = f \times \frac{12\,WH}{S} \quad (f = \tfrac{1}{3} \text{ to } \tfrac{1}{8}).$$

(*b*) Trautwine's—

$$\text{Safe load} = L = f \times \frac{46\,W\sqrt[3]{H}}{S+1} \quad (f = \tfrac{1}{3} \text{ to } \tfrac{1}{12}).$$

(*c*) Wellington's—

$$\text{Safe load} = L = \frac{2\,WH}{S+1} \text{ (drop hammer).}$$

$$\text{Safe load} = L = \frac{2\,WH}{S+\frac{1}{10}} \text{ (steam hammer).}$$

(L = safe load in lbs.; W = weight of hammer in lbs.; H = drop of hammer in feet; f = factor of safety; S = penetration, per blow, in inches, for average of last four or five blows.)

Where penetrations are as much as two inches or over there is not much to choose between all these formulæ; but for small penetrations the 1st one is evidently inapplicable, giving abnormally high results; on the other hand, the third formula is conservative under all conditions, simple in use, and admits of a modification for steam hammer driving, in which *stiction** is not an element to be considered. It is also applicable down to zero penetrations for ordinary weight of hammer, drop and length of pile, as $L = 2\,WH$ is about what a pillar 12 or 15 inches in diameter and, say, 20 feet long will safely stand (taking $W = 2{,}000$, $H = 25$).

These formulæ neglect many small losses of energy in driving, and are, therefore, only empyrical; but the results accord fairly well with the few facts known regarding the safe loads on piles. Evidently in ordinary soils, the skin friction is the important element in their sustaining power, as the load carried on the point of even a blunt ended pile would not be very great unless on solid rock.

Of the ordinary losses of energy in pile-driving, the only important one (neglecting the friction of the leads, the compressing of the pile, the bouncing of the hammer, which latter can be remedied by lessening the drop, or getting a heavier hammer), is the brooming of the head and point under hard driving. To prevent the former, a heavy iron band about three inches by one inch should be fitted around the head, and when brooming does occur, it should be sawed off at once. While in hard or bouldery ground the point should be shod with straps of iron and made rather blunt—in fact some drive with piles almost without a point, claiming that brooming is thus prevented—in quicksand, a pile turned butt downward will often be the only means of keeping it down during driving, and in all cases where piles are subject to severe vibration they will take a much less load than where it is a quiescent one. This is not included in the formulæ and must be provided for in the design.

For permanent piling in fresh water districts such woods as cedar, oak, yellow pine, rock elm, spruce and tamarac are in common use, being given somewhat in order of merit for durability, while any good wood may be used for temporary work. The cost for ordinary lengths will vary from five cents to eight cents per foot in favorable localities, to twelve cents or fifteen cents for oak piles at a greater distance, and even twenty-five cents or

* Stiction is that excess of frictional resistance offered, when a body is started from rest, over the continuous frictional resistance offered to a body while in motion, under the same conditions of surrounding material. C. B. S.

thirty cents per foot for the same in great lengths of fifty or sixty feet; driving will vary from two cents or three cents per foot in situations where great quantities are driven by steam hammer, to four cents or five cents per foot where driven by a track pile driver on cars; but for ordinary railway construction work, scattered and in small quantities, eight cents to twelve cents per foot is not out of the way. An ordinary price on railway construction is about thirty cents per foot for good piles, 12 inches in diameter at the small end, in place in the work, and fifteen cents per foot for all cut-off ends, this includes all labor of driving and cutting off to the exact height if on land, but cutting off under water is extra, and sometimes a matter of considerable expense.

Deep Foundations on Land. — Where foundations require to be carried down for any considerable depth, it is more economical to timber and sink vertically than to put earth slopes on the foundation pit, such timber will, in general, consist of vertical hand-driven sheet piles and horizontal rings of timbers and braces to sustain them at five or six foot intervals, as shown Fig. 67, Plate XIX.,

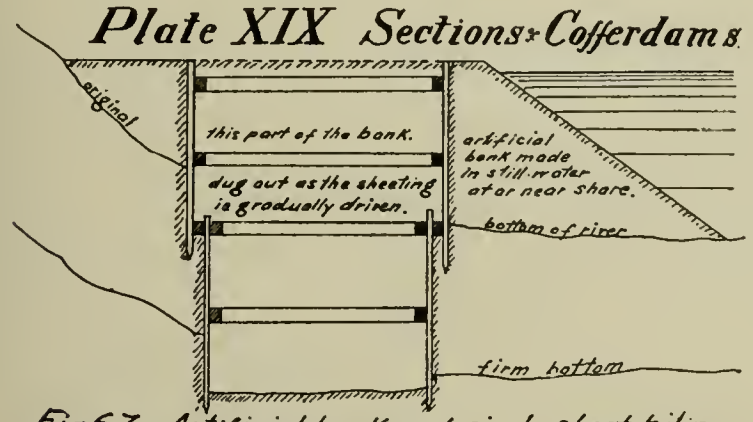


Fig 67. Artificial bank and single sheet piling.

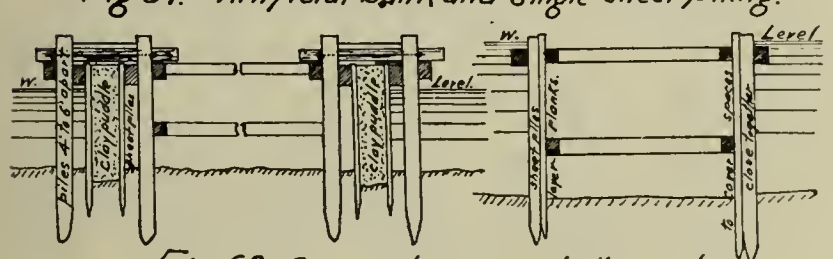


Fig. 68 Coffer-dams for shallow water.

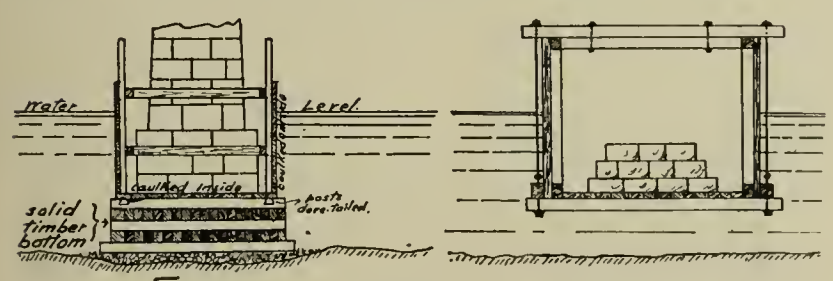


Fig 69. Floating Cofferdams on good bottoms.

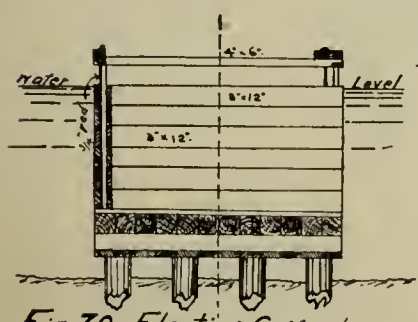


Fig. 70 Floating Cofferdam on piles

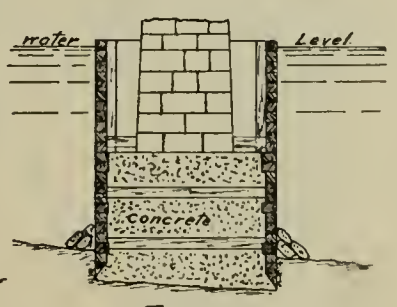


Fig. 71. Concrete-filled bottomless Caisson.

and in planning such work it is well to remember: (1) To allow for extra room more than is apparently required, in order to give freedom of movement, extra timbers, etc.; (2) To be sure to find out how deep it is to good bottom before digging is begun, in order to see whether piling might not be less expensive, and chiefly so as to be able to say definitely how many rings of timber there will be, and how much extra room will, therefore, be needed to step in all around about 15 inches every 10 or 12 feet in depth; this is a very important consideration. See Fig 67.

FOUNDATIONS IN WATER.

When masonry work is to be built in water, the considerations which determine the method to be adopted are: (1) The depth of water and its fluctuation in level. (2) The depth of soft material underlying the water which must be penetrated to secure good foundation. (3) The velocity of the current. (4) The money and materials available.

Of these considerations Nos. 1 and 2 are most important, and the total depth from water surface to bottom of structure will determine whether the foundation should be obtained by:

(*A*) Fixed cofferdams; (*B*), floating cofferdams, with solid timber bottoms; (*C*), bottomless cofferdams or caissons; (*D*), compressed air; (*E*), open dredging.

Fixed Cofferdams.—These are used where there is shallow water, at most only a moderate current, and where the bottom is of such a nature as to admit of sheet piles being driven in and the foundation suitably excavated to a firm foundation bed. This may be accomplished in various ways. Where the structure is near shore and waste excavation is available, it will pay to make an embankment above water level, and carry down hand-driven sheet piles kept in position by rings of timber, the excavation being always kept about level with the bottom of the sheet piles. This method is illustrated in Fig. 67. If, however, the structure is not thus situated, the sheet piles are either driven in a double layer, as in Fig. 68, or a single row of Wakefield sheet piling is used (this is an artificially made sheet pile composed of three planks spiked together to form a tongue and groove). If any of these methods are employed, a centrifugal pump will be kept busy keeping down the water while the foundation courses are being laid, but in case such pumping power is not advisable or available a more expensive form of cofferdam can be used, as in Fig. 68. Rows of guide piles are driven at considerable distances apart, then walings are bolted on, and a double row of sheet piles is driven around the area to be unwatered, between which is rammed clay puddle, making a very watertight, but expensive, cofferdam. This is generally employed in extensive works where the area is to be unwatered for some length of time.

Floating Cofferdams with Solid Timber Bottoms — It is moderately certain that as long as timber is covered with running fresh water it will never decay, and it is even contended that in any fresh water it is practically safe also; this has led to the adoption of methods of foundation building which do not involve the unwatering of the bottom. If the bottom is bare and moderately level, or can be dredged to a good bottom and levelled up with broken stone, it is manifestly easy to build a watertight box with either a solid timber (Fig. 69) or stone-filled crib, or only a plank layer, as a bottom (Fig. 69), and, after floating it into position, sink it, by building in it or by external loading, and after the structure has been built up above water level tear off the sides of the watertight box, leaving the bottom as a permanent part of the structure. If, on the other hand, the foundation is soft and good bottom can be reached by piling, the piles are driven to a firm bearing, sawed off under water close to the bed of the river, and the same operation as just described is gone through, the structure being landed on top of the piles as a foundation, as in Fig. 70. These methods are cheap and satisfactory in situations where the current is not excessive, but in very swift currents such constructions are not as manageable as the bottomless cofferdams to be described, and even where used, it is

found advisable to build the timber work and footing courses of masonry considerably (1 to 2 feet) larger than the neat work, which is laid out after the crib is in its final position. This provides for some permissible inaccuracy in sinking. The cribs are well drift-bolted together and the boxes caulked with oakum and dove-tailed or bolted down to the bottom, so as to prevent them lifting when the sinking process is going on.

Bottomless Caissons or Cofferdams.—Where no timber is desired under the masonry, or where the current is very swift, the method shown in Fig. 71 has been found best, but is only admissible where good foundations are easily obtainable. The bottomless box is floated into place, loaded until it sinks to the bottom, and then is either unwatered by having a large canvas flap around the outside of the bottom, held down by bags of concrete, thus nearly sealing the bottom, the caisson being then pumped out and the bottom excavated or levelled off with concrete, or else, if the bottom is already firm, as is usually the case in swift currents, there is no necessity for unwatering until a great depth of concrete has been put in, forming a watertight bottom; in the latter case, if there is an irregular rock bottom, the caisson cannot be made to fit it, and in order to keep the undertow from carrying away the concrete as fast as deposited, or even dissolving out the cement, it is found necessary to fasten a canvas flap around the inside of the bottom and load it down with bags of concrete, pea straw, etc., until a bottom has been formed And in depositing the concrete it is done by lowering an iron box, with a hinged bottom, containing about one cubic yard down to the bottom; the box is tripped, allowing the concrete to slide gently out, whereas it would become dissolved if allowed to fall any distance through water. After such a bed of concrete has been formed as is considered sufficient, the caisson may be pumped out and construction continued in open air.

Compressed Air.—Where a great depth of water and soft foundations are encountered the methods previously described must be abandoned. Early in this century the vacuum air process was tried, by which the excess of outside pressure forced soft materials up inside a vacuum chamber, this material being excavated, air was again extracted, and each time the hollow chamber of wood or iron sank down by its own or added weight; but this method was found uncertain in its means of directing the sinking, was capable of only limited application and failed entirely on encountering stiff clay or boulders, besides it did not enable the bottom to be personally examined and properly prepared for the foundation layers.

Very soon the plenum or compressed air process was tried, and to-day it is recognized as being in every way most satisfactory until greater depths than about 100 feet below water level are to be obtained, when open dredging through wells must be resorted to. Figs. 72, 73 and 74 show common forms of the same process. The drawings are almost self-explanatory, the pressure of air in the working chamber is constantly maintained, and the extent of the pressure must always be sufficient to keep out water; the tendency being for compressed air to be continually escaping around the working edges, and bubbling up to the surface outside the chamber. Where pneumatic cylinders are used, they are in pairs, sometimes braced together, the two supporting one end of a truss, and being completely filled with concrete after bottom is reached. See Plate XVI. One larger cylinder, as in the Hawkesbury bridge, with elliptical ends will, however, be much more stable.

Where large timber working chambers are used they must be very strong, as the whole weight of the pier will be carried on their backs until the working chamber is filled in, which is not until firm bottom is reached. It may be shod with iron or merely with timber, depending on the materials to be met with, and on top of this chamber may first be constructed a timber crib as in Fig. 74, extending up to the ground surface and filled with alternate pockets of concrete or broken stone sufficient to sink the chamber, which crib is built up gradually as the process goes on. Or, if advisable, the masonry may be commenced immediately on top of the working chamber as in Fig. 73, this will usually be done where the foundation is not a very deep one. The support which a deep caisson sunk by this method, or by open dredging gives to a pier and bridge, is partly by the bearing on the bottom and partly by friction on the sides, which is estimated at from 300 to 600 lbs. per square foot of surface, and is an enormous item in such a structure as that of Fig. 74, amounting to 2,000 or 3,000 tons. Of course, this resistance is not all to be overcome while sinking, for the continual movement and escape of a film of compressed air tends to aid sinking by lessening friction.

The material to be excavated is forced out of the discharge pipes by the compressed air, if it is finely divisible, by opening valves at the mouths of flexible pipes, but boulders, gravel, logs, etc., must be laboriously taken out of the air lock in small quantities, making the operation costly. The air shaft and lock form the means of ingress and egress, and it is a question whether it is safer and more convenient to have the air lock near the top or bottom of the shaft, the former, however, being safer for the men. The process of working the lock is to open one door, pass in, close the door, open a valve so as to raise or lower the pressure as the case may be, and then open the other door and pass on, some time being necessary to prevent injury to the lungs and ear drums; men can work in about

Plate XX

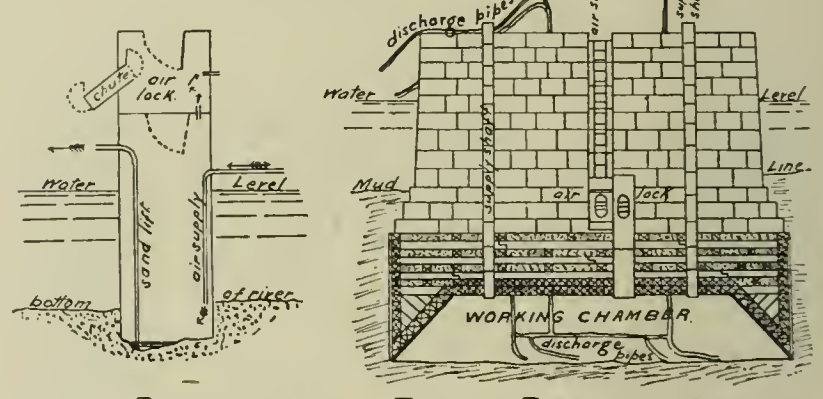


Fig. 72 Pneumatic Pile. Fig. 73 Pneumatic Caisson.

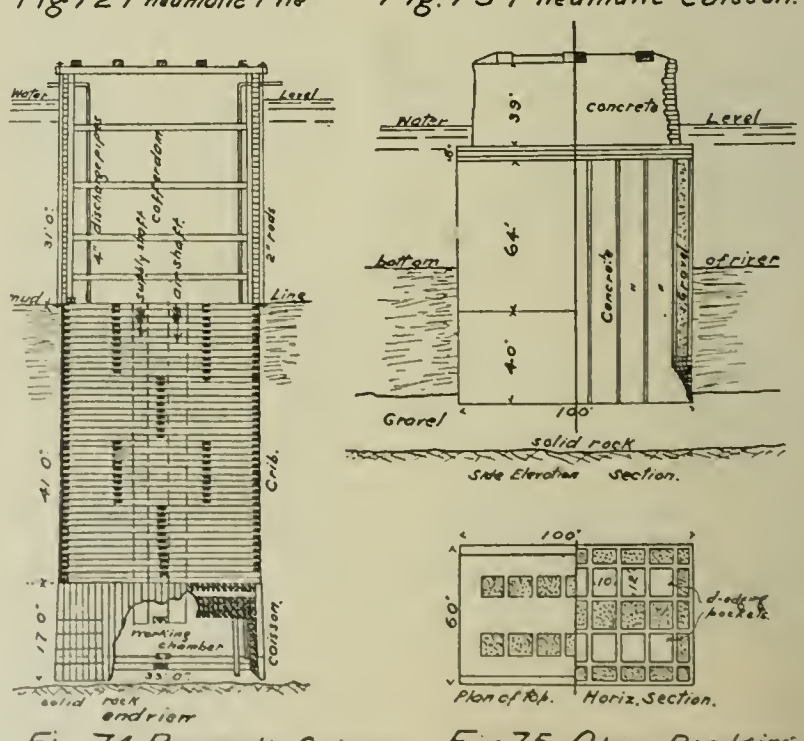


Fig. 74 Pneumatic Caisson with Crib and Cofferdam. Fig. 75 Open Dredging Caisson for Pier.

4 atmospheres pressure as a safe maximum, and then only for three or four hours for healthy men; with less pressure the period of labor may be lengthened, but on coming out to the open air the depressing effect of a lowered pressure must be counteracted by a strong stimulant like coffee, to prevent injurious consequences; and for reasons of safety the compressed air is taken from a receiver and not direct from the compressor. So that an accident to the machinery might not have an immediately disastrous effect by permitting an inrush of water before the men could escape.

The supply shafts marked are only used at the last, where concrete is passed in through them, to fill up the working chamber. The shafts themselves are also all filled with concrete, and the whole structure is a solid mass of timber, concrete and stone. Sinking foundations by compressed air has many advantages—the sinking can usually be quite accurately directed; it enables all the pier construction and excavation to proceed together; it enables all kinds of materials to be removed, and it permits of a careful examination and preparation of the bottom before concrete is put into place.

An example of such construction is detailed in Patton's "Foundations," at a cost of

$16.82 per cubic yard for the caisson material;
$10.76 " " crib "
$7.83 " " sinking "

making an average of about $20 per cubic yard. This was for a depth of 68 feet below water and in 56 feet of mud—evidently the cost would vary with the depth and the materials encountered, in this case the sinking was at the rate of 1½ to 2 vertical feet per day.

Open Dredging.—This method has been long practiced in India, where circular brick wells are built with heavy walls, and gradually lowered through soft soils by excavating and undermining, the material being raised in some primitive manner. This is improved upon now by using steel cylinders and excavating by clam-shell or other dredges. There is usually difficulty in controlling the direction of movement, and large logs and boulders are troublesome. So that open dredging is usually used only where the depth is too great to admit of using compressed air and where the materials can be freely dredged (in India, submarine blasting of boulders, etc., tended to crack the cast iron cylinders, but would, probably, not have a bad effect on timber cribs). A striking example of this process is that of the foundations for the Poughkeepsie bridge, which were sunk through a depth of 50 to 60 feet of water and 75 to 80 feet of mud, clay, sand and gravel, or a total distance of 140 feet below high water. (See Fig. 75.) The cribs, 100 feet by 60 feet, had 31 gravel pockets, extending from top to bottom, which afforded enough load to sink the cribs when undermined; there were 14 dredging wells extending from top to bottom 10 feet by 12 feet, in cross section, through which the dredging was done by a clam-shell dredge. The walls were 2 feet thick of solid timbers, laid in alternate lapping courses, well drift-bolted together, and after the cribs arrived at good bottom the wells and pockets were filled with concrete, and a floating caisson similar to Fig. 69 was brought out into position and built into until it sank on to the top of the crib. The chief difficulties in carrying out this process, aside from anchoring such a huge mass of timber in a swift current, preparatory to dredging, are that it is difficult to guide the crib in direction as it settles down, and that logs, boulders, etc., under the cutting edges, cause delay and necessitate, often, sending down divers. A combination of compressed air and open dredging has been used in Europe, in which several working chambers surround an open well, the men force the material out under the inner edges of the working chambers from which it is removed by a clam-shell dredge; the process is cheaper in handling the material, but uses an enormous quantity of compressed air.

(To be continued.)

For THE CANADIAN ENGINEER.

DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON.

(Concluded from last issue.)

Lately the scientific journals of the United States have been reporting a process of garbage disposal invented by a person named Harris. I visited his experimenting room and examined the garbage gas manufacturing machine, consisting of an extra large wood burning box stove, covered by two iron tubes, which acted as retorts for carbonizing the garbage, with another tube on top of the two, which answered for a superheater or reburner of the gas after leaving the retorts. I saw four lights of gas burning, stated to be from the gas manufactured from the garbage in the retorts, but after reading the description published on page 170 of the October issue of THE CANADIAN ENGINEER, I feel almost certain that the gas I saw burning was made from the coal oil, and, probably, chemicals that were mixed with the garbage when charging the retorts. I do not believe that Mr. Harris has found a chemical that can work what should be called a miracle, supposing that the reports should be true. A fuel gas can be made from vegetable or woody garbage that would add a great quantity of heat to a fire composed of wood or coal fuel, but would make a poor show if depended on to give heat or light alone. But even this kind of gas can scarcely be made with the little heat that can be generated with the experimental box stove, and I base my opinions on a two years' experience in the manufacturing of illuminating gas from sawdust, and the lessons I received, teaching me how to make water gas, and when I have explained the two methods, my readers will be able to judge the soundness of my views.

If ten pounds of melon skins and potato peelings be properly dried until all the moisture is extracted, it will be found that the vegetable substance left will weigh under 3½ pounds, proving that there was 6½ pounds of water in them, so that there is 3½ pounds of vegetable that can be made into fuel gas by a heat at a temperature of about 2,000° F., and 6½ pounds of water that can be made into a good heating gas, by first converting the moisture or water into a high pressure steam, then passing the steam through red-hot pipes which super-heats it, making the steam gaseous, then discharging it on to a fire heated to a temperature of about 3,000° F., in fine small jets, it is then turned into large volumes of gas, and by allowing drops of coal oil to drop on to the fierce fire along with the fine sprays of gaseous superheated high pressure steam, a passable illuminating gas is made at about the third of the price Harris declares he can make gas from garbage. In making gas from sawdust, we carbonized sawdust that was first dried well upon hot plates; if we needed illuminating gas we carbonized pine wood sawdust containing plenty of resin, which was probably the substance that gave out most of the gas needed. If we were well stocked with gas, we then carbonized dried hardwood sawdust that made large quantities of valuable acids; but we could not use wet sawdust to advantage, no more can Mr. Harris use wet garbage to make gas, for the two materials have a similarity. If we used sawdust in an undried state it condensed watery acids and threw off a

gas, useful only to burn under the cast iron retorts along with the bunch wood. So, plainly speaking, Mr Harris cannot make a combined vegetable and water gas with the heat that can be got out of wood burning box stove, because the heat needed to make gas from watery vapors would melt both his stove and his iron retorts, and the gas got from vegetable refuses will not be profitable to manufacture into illuminating gas.

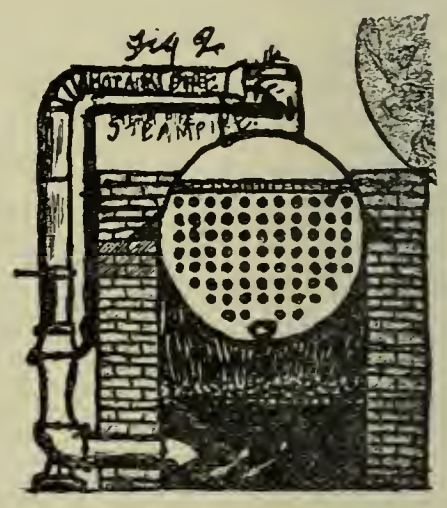
The scientific papers of Great Britain make fun of the reports published in the United States about the garbage gas invention, and laugh the project out of court, saying that the reports read like fairy tales. There is a sarcastic article on page 522 of the *Surveyor*, printed in London, Eng., Nov. 5th, that handles Mr. Harris' reports of his invention without gloves.

It is in order for the inventor to prove that he has found a chemical that will totally change vegetable substances and give them a virtue equal to coal that has taken the earth thousands of years to instill into its nature the gas and heat-giving properties. When that can be done I will gladly welcome the invention.

In Bradford they destroy bad meat and fish by a machine similar to a boiler, that possesses a steam jacket, and revolves, and is evidently filled with knives, for after the wet meat has been in and revolved about an hour, it runs out through a small hole in a fine dry powder, of great value for fertilizing, and the residue of the furnaces is manufactured into mortar, etc. They also find a paying market for every castaway found in and picked out of the rubbish. With the heat evolved they generate electricity and supply power for useful purposes. At Southampton they have lately set in a few extra furnaces of the Goddard, Massey & Warner's type, with forced draught appliances, making them capable of burning 15 tons a day. Multitubular steam boilers are erected on the top of these furnaces that generate steam to a pressure of 160 lbs., which is used to pump and turn the machinery that chemically treats the sewage of the town. The boiler being placed on top of the furnaces will cause the hot gases to have a continuous rising grade from the furnace to the chimney, while in other destructors the gases drop down several feet from the combustion chambers to the underground flue, often as much as 15 feet. This system will be highly satisfactory to engineers, who believe that bending and dropping the flues, and compelling the smoke and heat to go down hill, spoils the draught and wastes the heat. The destructors at Rochdale are somewhat different to the others, being fired by hand through the clinkering doors at the front, similar to the Lancashire boiler. This has the advantage of its being possible to spread the refuse evenly over the fire and of the proper thickness to insure quick combustion, destroying a larger quantity of refuse than those that are fed from the top, but, on the other hand, the objectionable stuff has to be tipped on the ground floor in front of the furnaces, in place of on top out of sight of most of the attendants, and where the smell can be least perceived. The boroughs of Dewsbury and Warrington have the high temperature destructor furnaces designed by Beaman & Deas, which supply the largest number of units of heat, and a small residuum of well-burnt clinker and ash. They create a great heat from the foulest refuse and garbage that can be handled, supplying a greater amount of heat per lb. of rubbish consumed, besides completely destroying the poisonous fumes usually thrown off when burning excrement, offal, etc.

These furnaces are built in pairs, the fire bars being horizontal, at the rear end there is a sloping, inclined, drying hearth and it has the feeding door at the back end, where the refuse is usually thrown in by hand labor, and when the fires are cleaned and clinkered at the front doors, the refuse which has dried with the heat from the furnace during the time it has been lying on the drying hearth slides down on the top of the fire. There is only one combustion chamber to each pair of fires. Each fire is fed and cleaned alternately, so that when one fire is newly charged with green refuse, and consequently at its coolest period the twin fire is at its highest temperature, and both having to deliver their discharged smoke and gases into one and the same combustion chamber, the high temperature of the one mixing with the low temperature gases of the other, reburns it and raises it up to a high temperature. Thus, the combustion chamber remains at a white heat, which fully destroys any unconsumed fumes of foul gas that may be cast off by the furnaces. A suitable fan is used to create a forced draught which delivers the current of air into the closed ashpit, thus the air is forced pretty evenly between the grate bars into the body of the fire. The crown of

FIG. 1.



the arch over the fire, called the fire screen, being the partition between the furnace and combustion chamber, is perforated with holes near the front, over the cleaning door, for the escape of the smoke and gases, which compels the fumes from the roasting refuses on the drying hearth to pass over the fire from back to front before entering the combustion chamber. Perhaps the most advantageous and valuable feature of this destructor is the hollow firebrick fire-bridge that forms a passage of atmosphere air from the outside to the rear end of the combustion chamber, where it enters through a quantity of small distributing holes, adding a quantity of warm air to the fiery gases entering the chamber, supplying them with the oxygen needed at that point to reburn and increase the temperature of the gases sufficiently to thoroughly burn and purify the obnoxious fumes. It will be obvious that the cold air passing through the fire bridge must pick up a large quantity of heat by radiation and enter the combustion chamber at a moderate temperature. It is stated that the clinker comes as low as 25 per cent. of the weight of refuses destroyed, while the slow combustion only reaches 33 per cent., a difference of 8 per cent., which means a great deal in the cost of cartage where the residuum of the furnaces has no handy way of being disposed of or manufactured into mortar slabs, paving brick, etc., etc.

This type of destructor has been improved upon in several ways, viz.: In place of using a cold air fan, which chills the fire at the point of attack, cooling the clinkers and causing them to stick to the grate bars, a combined steam and warm air blower is used similar to the steam blower mounted by R. S. Earl, of Toronto, over ten years since, and employed by many steam users in Canada and United States. It consists of a bunch of fine steam jets discharged into about a 9-inch tube, something similar to

Fig. 1 and Fig. 2, which shows the blower in the act of giving a forced draught to a steam raising boiler. This will help to explain how the machine acts in this kind of a destruction furnace. It shows that the supply of air in that case is drawn by the exhausted steam jets from over the heated boiler, and mixing with the hot steam in the ashpit, where it enters the furnace between the bars at a high temperature, without the least shock or cooling effect to the outer edge of the body of the fire. When applied to a destructor furnace the air and steam is superheated on their way to the ashpit from the blower, by passing through the hollow, square cast iron tubes that form the side walls of each furnace (see Fig. 3 and 4.) The steam blower is fixed in position at the side of the inclined drying hearth (see Fig. 4), and at the point where it enters the hollow walls. Arrangements are made to draw off the fumes discharged by the roasting refuse, forcing them into the ashpit to be passed through the body of the fire, which thoroughly cremates them. It will be seen by the sketch that the blower exhausts the foul air both from the tipping floor, where the men stand to charge the furnaces, and the drying hearth behind the fire, thus making the handling of unhealthy and disagreeable excrement or offal almost as healthy as ploughing a field, besides giving a strong forced draught to the fire, saving the expense and doing double the work of a tall chimney. The firebrick sides of furnaces are usually the place where repairs are oftenest made, and it is an improvement to have hollow iron boxes, because they form a passage for the steam and air, which prevents them from ever getting red hot and burning out, as all firebricks appear to do at this point, therefore besides being of material use, they also save expense and annoying stoppages, but on the other hand they will have an acute chilling effect on the fire, which is made up again, by extra efficiency and power of the steam draught, and the extra units of heat made from the chemical combination

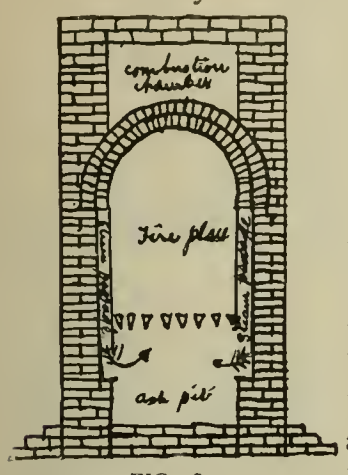
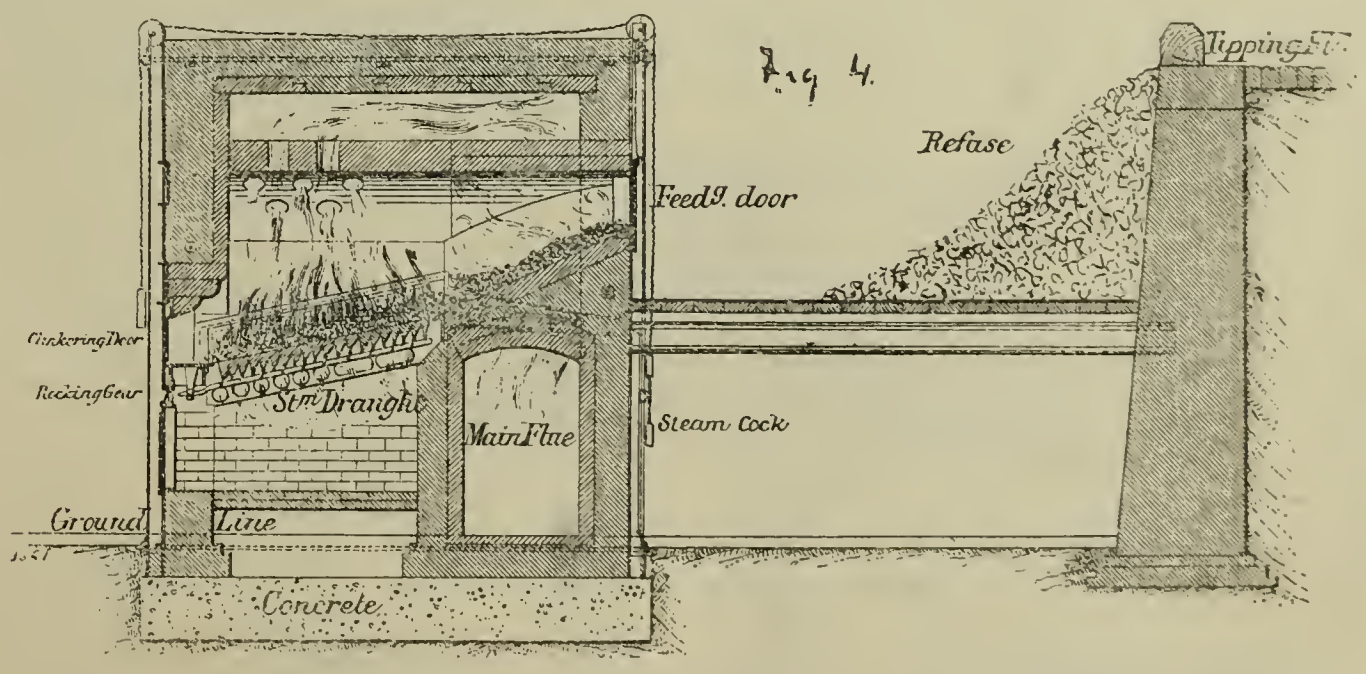


FIG. 2.

of the steam and the burning material. At Oldham, Hamburg and other places these improvements are in full working order. They are patented and controlled by the Horsfall syndicate, even to the rocking bars and steam blower, which are purely American. The cost of construction and full equipment is about $500 for each cell or furnace, when the number of furnaces built exceeds four in a block.

It will be noticed that the Beamans and Deas plan of building the furnaces in pairs, each joining with one combustion chamber, and the introduction of oxygen into the combustion chamber, are advantages that go far to counterbalance the improvements controlled by the Horsfall syndicate. In other points they are similar in build, and if the good points of each could be combined, a unique and powerful destructor would be produced. In European towns that have a close packed and dense population they have as many as thirty furnaces grouped together in a circle or other convenient design, having a large secondary combustion chamber or vault that receives the flues from all the first and separate combustion chambers; the walls of this vault get red hot and assist in again mixing and reburning the gases, thus for a second time increasing the temperature and purifying the gases cast off by the refuse and offal of each furnace. The annexed illustration (Fig. 4) shows a sectional elevation through a Horsfall furnace with the latest improvement attached; Fig. 5 shows the position of the ten furnaces in the small town of Oldham, England. The chain governing the steam valves that cut off the steam from the blowers when the man desires to open the front doors is shown passing over the head of the furnace and hanging down to a convenient point. The fire screen, the combustion chamber, the drying hearth, the rocking fire bars, and the route that the smoke and gases are compelled to take are all clearly shown to the point where they enter the flues on their way to the general collecting vault, from which they are conveyed to the boilers which generate steam, that creates power to run any kind of machinery necessary to do the power business of the town, and the temperature of over 2,000 deg. Fahr. is reduced to about 600 before it enters the chimney, which may discharge the purified gases close to the windows of a closely built district, without the slightest injury to health or contamination of the atmosphere.

We are told by parties that have visited and investigated the details of construction of every kind of destructors at present working in Great Britain, that the managers, the inventors and attendants of each kind assure the visitors that their system is by far the best, and point out the advantages, showing high-class testimonials,

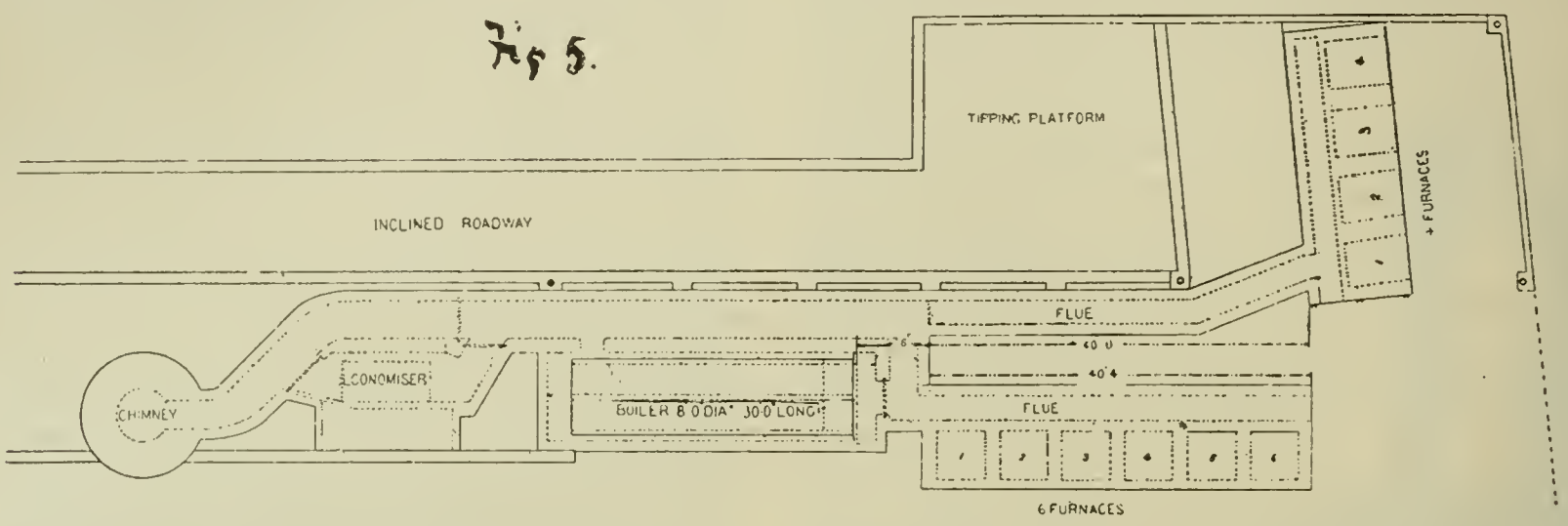


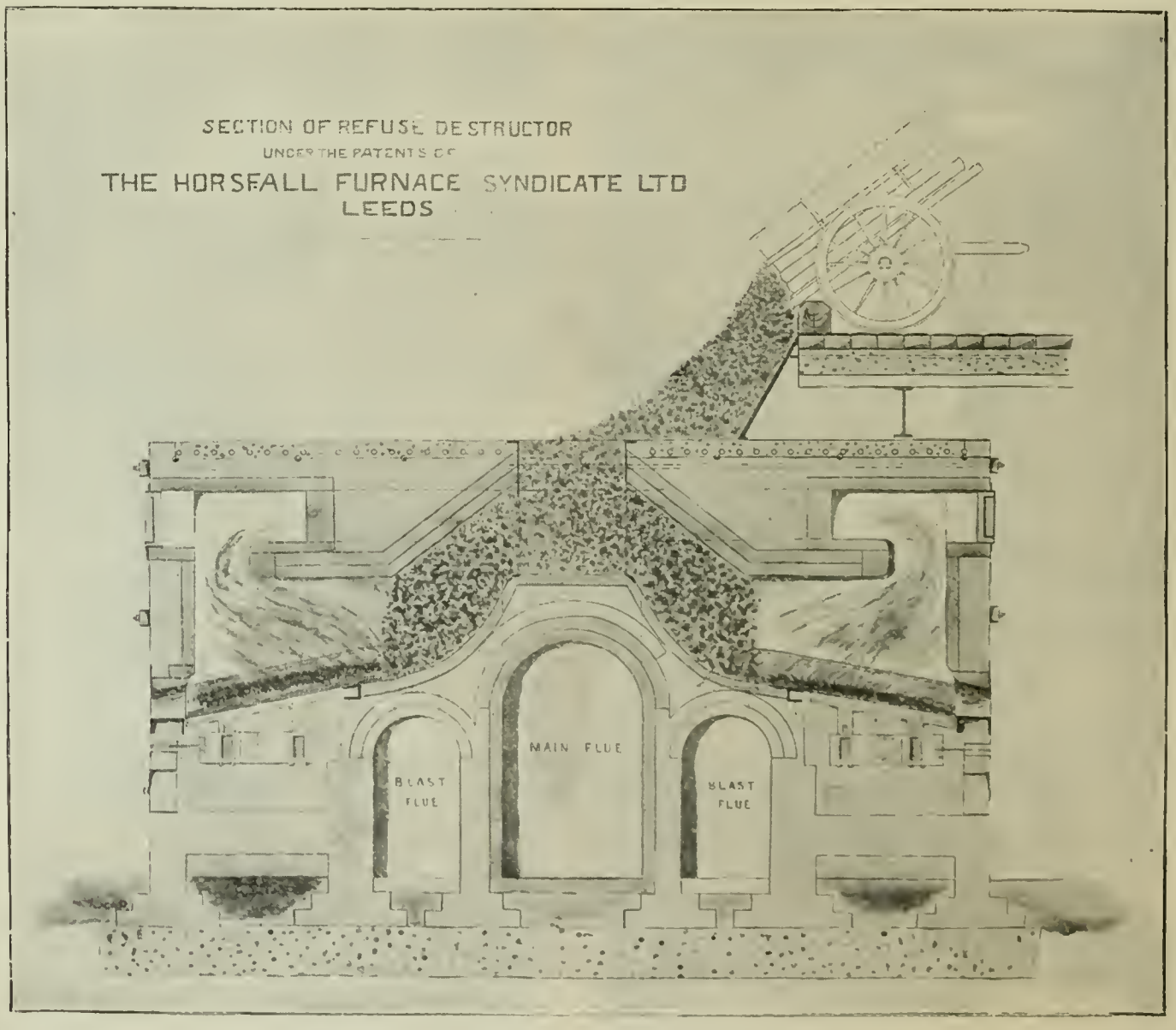
besides many pages of praise written in their book by previous visitors, which goes a long way towards mystifying and misleading deputations seeking knowledge. Those using the slow combustion and low temperature class, point out that one man can attend to fifty per cent. more fires than the men who attend the high temperature furnace, which may be true, but it is also true that the man attending to two high temperature furnaces consumes thirty tons of refuse each day, while the man who attends three low temperature fires, or one more than the other man, only

destroys twenty-one tons, or nine tons less than the man that only attends to two high temperature forced draught fires, so that their plausible argument is ridiculous when worked out in figures. They have a more combative objection, they say that the high temperature furnaces will soon burn out and the repairs will come high and expensive. Past experience of the few years that high temperature furnaces have been in use continually does not bear out the statement, for they remain sound and whole in places where they were well and properly erected, proving this argument wrong. The slag that attacks the brick in high temperature furnaces, and often believed to be caused by melting and running of the fire-brick, appears to have been proved by experts and experiments, together with careful watching during the past three years, to be silicious particles produced by the burning refuse and forced by the blast against the brick work, and can be easily knocked off. They also assert that it protects rather than damages the walls; this information is very satisfactory, and it is to be hoped that some person will find out a way of reducing silicious matter to either a powder or a gas, so that it will cease to be troublesome because it is a non-conductor of heat, and any combustion chamber lined with stalactytic formation will be useless as a re-burner of fumes and gases.

The solid advantages of high temperature furnaces is, that they burn all the fumes and injurious gases, without the aid of an expensive fuel eating cremator; they extract more heat, they reduce the refuses to the smallest possible weight and bulk, they make a harder and better clinker, they extract more heat per lb. of refuse and do double the work of the slow combustion type with less labor. Most of the low temperature sort are being altered and a forced draught added, making them into high temperature destructors, some of them on account of complaints that the unburnt fumes being discharged from their chimneys are a public nuisance. Before closing the subject of refuse disposal of towns, I might describe a useful refuse or house garbage destroyer, that if well built and carefully attended to when in use will be useful and valuable to any high-class residence or public building, placed in a country position where they cannot have the comforts of modern sanitary appliances, except they construct private ones for themselves. And where such places have their own private drainage and sewage disposal works this simple garbage destructor machine seems necessary to prevent the grosser solids, paper, grease, etc., from passing forward to the sewage settling tanks and choking the valves and pipes. The illustrations here produced, together with the explanatory references, will go a long way to

Fig 5.





explain the working of the machine. The apparatus consists of a series of perforated swinging buckets, holding about 1½ cubic feet, hung on a cross-bar, which holds in position the arms radiating from a central shaft similar to the Ferris Wheel. They are enclosed in an air-tight case, which has a connection by an iron pipe to a chimney and a 4-inch iron soil pipe that bring all the excrements and

Fig. 6

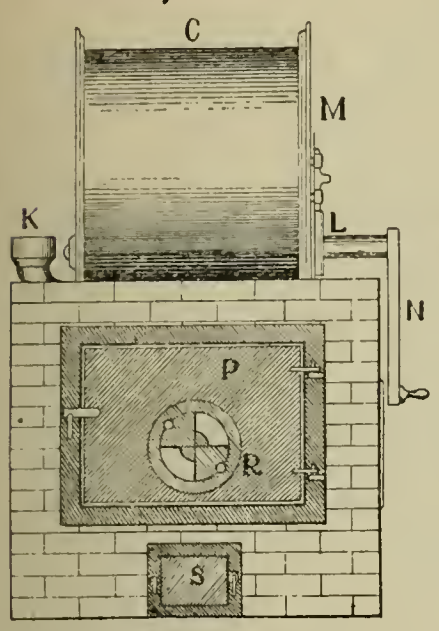


Fig. 7

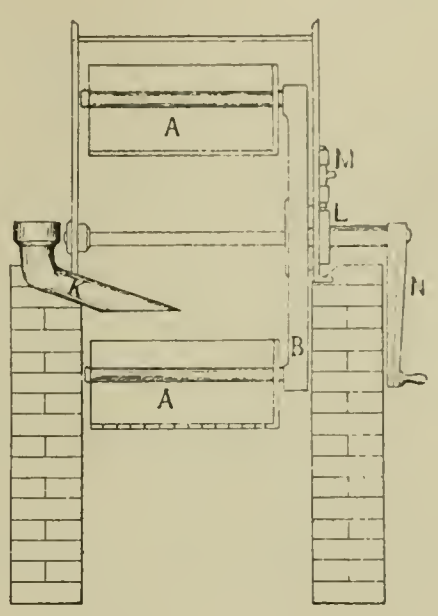


Fig 8

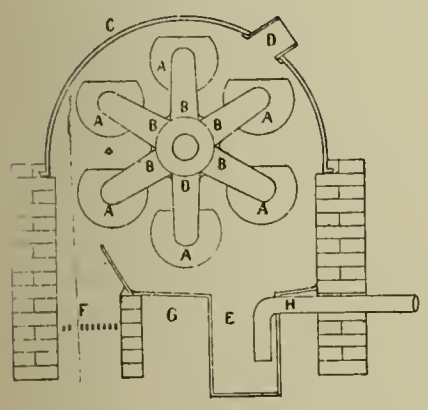
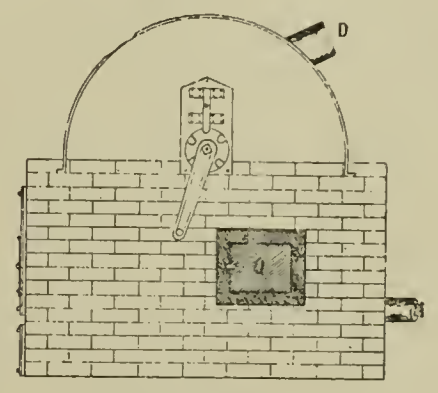


Fig. 9.



A A A are the buckets or baskets of about 1½ cubic feet capacity *B B B* are the arms supporting buckets. *C* is the casing resting on an 8-inch wall *D* is the opening and thimble to connect to chimney. *E* is a grease trap made of common tiling. *F* is the grates. *G* is sand or clay filling. *H* is sewer pipe. *K* is cast iron intake pipe, *L* is ratchet wheel. *M* is the pawl to engage with ratchet to hold buckets in place. *N* is the crank arm. *O* is a door to get to grease trap. *P* is large door for access to buckets. *R* is a damper to regulate drafts. *S* is the ash-pot door.

sewage made in the building to the swinging buckets, together with the house garbage (except coal and wood ashes), which all fall and enter into the lowest bucket. The lowest bucket is securely held under the soil pipe, and when one is filled with the grosser solids, the attendant turns the wheel a notch, raising the full bucket up out of the way and leaving an empty one under the soil pipe. By the time the sixth bucket gets full the first is dried by the current of air circulating through the machine by way of the fire bars and chimney. The machine is so constructed that the sludge cake is easily turned out into the fireplace and the bucket swings back into its place. When the furnace place gets full with dry cakes, they are set on fire and quickly burn by themselves, and at the same time dry the contents of the six swinging buckets. If this cremator could be fixed near but outside of private buildings, it would answer for isolated places. There will be some smell from the machine, and the fumes from the burning sludge will pass out from the chimney when the sludge cakes are burnt about once a week, but the contrivance seems the best in sight yet for country places, and a great improvement on the present system in use.

A large number of towns dispose of their rubbish by sorting and cleaning that part of the rubbish that cannot be made into a manure, using the carbon and inflammable material for generating steam, and to enable the sorting to be done in a healthy atmosphere and without soiling the dresses of the employees, the best and latest designed machinery is used. By so doing, the cost of collecting the refuse is about covered by the sale of the products. Most of the cities and towns adopting this plan also adopt the pail system of privies, in place of vault privies, and very few water-closets are in use, because, having a well-disciplined army to regularly go around once a week or oftener to remove the full one, clean the place of lodgment out, and replace a well cleaned, disinfected pail, the places are kept sweeter and healthier than 90 per cent. of the water closets in use, and the sewage of the town is easier handled, being almost void of excrements. There are also towns which have the dual system of manufacturing manure and selecting out salable castaways, also destructor furnaces to consume the most objectionable offal that is collected.

Whatever system is adopted, the success and healthful efficiency almost entirely depends on cleanliness and well-disciplined management.

For THE CANADIAN ENGINEER.

WATER MAIN CLEANING IN ST. JOHN, N.B.

BY W. MURDOCH, C.E.

There are three leading mains supplying the city of St. John, N.B. Number one, 12 inches in diameter, was laid in the year 1851; number two was laid in 1857, and has a diameter of 24 inches; number three also twenty-four inches diameter, was laid in the year 1873. The reservoir from which the city's supply is derived is an artificial lake on Little River, distant five miles from the summit of the city and 160 feet above the level of high water in the harbor. The summit of the city is 130 feet above h.-w. datum, and the hydraulic gradient in summer time generally reaches this district at an elevation of about 145 feet, the fall being thus about 15 feet, and the head of water 15 feet. In winter this head of 15 feet has been known to disappear during lengthy periods of zero weather when water was being wasted to prevent freezing.

The two older mains had become so foul through internal incrustation that, when No. 3 was shut off for repairs and the city depended on the other two pipes, all the portions at a height of 80 feet or more above datum, comprising an area of about 200 acres and containing a population of about 8,500 souls, were without water. On the other hand, with No. 2 shut off and supply coming by Nos. 1 and 3, every pipe was full and water delivered at a level of 130 feet. This was an ample demonstration of the foulness of the old mains as compared with that last laid. In the summer of 1897 the common council passed an order directing that the mains be cleaned, and preparations were forthwith begun.

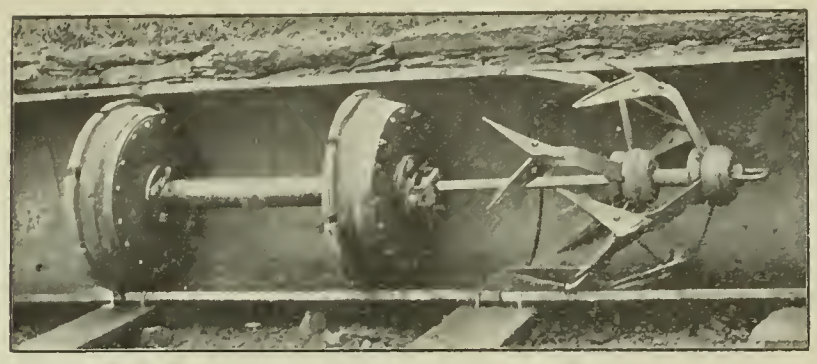
There being no hatch boxes on the main lines, such fittings had to be designed and tenders asked for their manufacture. James Fleming being the lowest bidder, he was awarded the contract at two cents per pound. Delivery began in the month of October, and the work of cleaning No. 2 was started soon after. In designing the cleaner or mechanical scraper, special precautions were taken to avoid the misfortune of having it lodge in the pipe with such consequent vexations, searchings and cuttings of pipe as have often occurred elsewhere. The desiderata laid down were:

a. That the apparatus be as light as possible, so as to

be easily projected up ascending gradients by the pressure of the water, and to offer generally as little resistance as possible whether through inertia or otherwise.

b. That as it is more desirable to take light cuts and make frequent runs, than attempt to remove all the dirt at once and have the scraper stick; therefore, the pistons should be so loose as to permit a free escape of water to carry off the loosened dirt in advance of the cleaner, and that the arms be not so rigid as to hold it up against any hard and abrupt obstruction encountered.

With these maxims in view, the machine was made as shown in the accompanying cuts, the pistons being



MECHANICAL SCRAPER, USED IN CLEANING ST JOHN, N.B, WATER MAINS.

of birch set in layers, each layer being one inch in thickness and placed crosswise of the other to prevent warping and increase the strength of the piston. Leathers were secured to the piston by means of an iron ring bolted against them, the bolts running through the piston. The spindle connecting the two pistons is of 3-inch wrought-iron pipe with a cast-iron flange screwed on each end and pinned over with a hammer to prevent the screw backing out. These flanges are each bolted through the piston to another flange on the opposite side. Projecting beyond the forward piston is an iron rod fitted with two sets of radial arms sloping back as shown in the cuts. There are four arms in each set made of No. 10 (B.W.G.) spring steel two inches wide, and each fitted with a forged steel scraper on the end, of the form shown in the drawings. The long sloping fish-tail form of this scraper enabled it to glide safely over every obstruction. In making the first runs, only one set of scrapers was attached; but in the latter, the whole eight were in use. This precaution was taken for the reason given, viz., lest a large amount of dirt should be loosened at once, and the cleaner become buried and stop.

A section of No. 2 main extending from the reservoir toward the city, a distance of about 6,000 feet, having been prepared by inserting a hatch-box at each end, the work of cleaning began on October 12th at 1 p.m., and was continued that afternoon. The head of water upon the upper hatch-box was 20 feet and on the lower 27 feet. The first run took four hours, for the reason that a cord sufficiently long to reach the whole length had been placed on a revolving drum 10 feet in circumference, and furnished with an indicator to register the revolutions. The end of this string was attached to the cleaner, and a record kept of its location as it sped along. But when the first flushing branch was reached the twine drifted out here and down the brook, while the drum kept on revolving and the indicator registering until the whole string was paid out. Meanwhile the cleaner had become securely moored near the flushing branch and could not be liberated until the stop-cock was dug to and uncovered. On the twine being cut and pulled out and the stop-cock lid restored, water was let on again and the cleaner finished its journey, a distance of 2,200 feet in about five minutes. This first run was sufficient to show that twine was dangerous, and we also learned that it was entirely unnecessary, for the grating sound of the cleaner as it passed through the pipe was heard quite distinctly by the two watchers under their feet as they followed the sound along the line. Two more runs were given that same afternoon, the time occupied to go the distance being about twenty minutes. The water was inky black for some time as it flowed from the flushing pipe, and it was allowed to run for two hours after the cleaner had been removed, this time having been required for the water to clarify.

The next section was taken on Saturday, October 23rd. It extended about 6,600 feet cityward, but in order to give the first section another scraping it was concluded to insert the cleaner at the dam and run it through the entire $2\frac{4}{10}$ miles. A misfortune was met this time in the following manner: The leathers having worn out during the first cleaning were renewed with a harder and stiffer quality than formerly, but they repeatedly caught in a new joint made while inserting the hatch box. Each time the lid was removed to ascertain why the cleaner did not start, it was found firmly fixed by this imperfect butt of the two pipe ends. After twice extricating it and again finding it caught in the same way, a jack-screw was applied to push it past this obstruction, the lid was again put on and the water let in at 4.05 p.m., and this time it started. At each of the five flushing stations the gate was left open fully ten minutes after the cleaner had passed, and then closed. As soon as the gate was closed the cleaner again proceeded, and the scraper, with only one piston, reached the end of its run at 5.25 p.m., having been one hour and twenty minutes going 2.4 miles, but when 50 minutes of a total stoppage are reckoned, the machine was found to have been in motion 30 minutes. As stated, only the forward part of the cleaner arrived, and search had to be made for the remainder. Nothing was done on the following day, which was Sunday, the castaway piston, which was lying obliquely somewhere in the pipe, having but partially obstructed the flow, and the water was left on until the Monday night following.

A receiving chamber unites Nos. 2 and 3 mains near No. 3 hatch box, and they are controlled by stop-cocks on each side of the receiver. It was, therefore, an easy matter to reverse the current of water in No. 3 by closing the stop-cock at the dam, and opening that at the receiver, as well as the flushing branches. This was done, and men were distributed along the line to listen for a rumbling noise, which at length was heard within about a quarter mile of hatch box No. 3, from which the cleaner had been extracted. The sound was followed along the line toward the reservoir until hatch box No. 2 was reached, when the derelict was taken out, after having travelled nearly a mile and crossed a valley about 90 feet in depth. It was found that the pressure of the jackscrew in forcing the cleaner past the uneven joint had cracked one of the flanges, with the result that after having travelled about 2¼ miles the cleaner fell apart. The forward part, comprising a piston and the scraper, pushed on, but the spindle attached to the rear piston fell to the bottom of the pipe, ploughed up some dirt and finally became embedded and jammed. The reverse current striking the piston as it did, drove it back with the spindle trailing behind. The apparatus was repaired and three more runs made through this double section of 12,600 feet, on October 29th, without any further mishap, the time taken for each run, including ten minutes stoppage at each of the five flushing stations, having been from 1 hour 46 minutes to 1 hour and 55 minutes. The cold weather being on when

the next castings arrived, cleaning operations were suspended for the season, to be resumed next spring.

On testing the efficiency of the cleaned main by shutting off No. 3 from the reservoir to the receiving chamber, where both unite, and bringing the supply through Nos. 1 and 2, it was found that the pressure in the city was as good as when No. 2 was shut, and the whole supply coming through Nos. 1 and 3, thereby showing that the capacity of No. 2 had improved to such an extent that whereas, with No. 1 it had formerly delivered to a height of 80 feet only, when unassisted by No. 3, and left 200 acres of the city, containing 8,500 inhabitants, without water, now the whole city could be supplied without the help of No. 3 and the water rise to a height of 130 feet above high water. The general improvement in pressure with all three mains on was found to be about four feet. Nearly two miles of this line remain yet to be cleaned, after which the other two. pipes will be taken as soon as the coming season permits

For THE CANADIAN ENGINEER.

TORONTO MAGNETIC OBSERVATORY.

BY R. F. STUPART, DIRECTOR OF THE OBSERVATORY.

The importance of obtaining a correct knowledge of the elementary facts of terrestrial magnetism, for the purpose of supplying a foundation whereon the advancement of that science on inductive principles may be based has for long been strongly and extensively felt.

From an early period of the meetings of the British Association for the Advancement of Science, the interest of terrestrial magnetism had received no inconsiderable share of the attention and exertions of its members. In the year 1834 a magnetic survey of the British Isles was commenced and carried through in the two following years by the joint labours of five of its members. In 1835 the association called for a report from one of its members, on the state and progress of researches regarding the geographical distribution of the magnetic forces on the surface of the globe; proposing to ground on the preliminary examination an application to the Government to aid in the prosecution of the enquiry in remote parts of the earth, unattainable by the means at the command of the association itself or of its individual members. This report, presented in 1837, was taken into consideration at the meeting of the association, at Newcastle, in 1838, and a memorial was addressed to the Government which, being favorably received by Her Majesty's Ministers, originated the naval expedition equipped in the following year for a magnetic survey of the high latitudes of the southern hemisphere. Deeming the opportunity a fitting one, the British Association availed itself of the same occasion to solicit the attention of Her Majesty's Government to the expediency of extending the researches to be accomplished by fixed observatories to certain stations of prominent magnetic interest within the limits of the British Colonial Dominions; the stations named were Canada and Van Diemen's Island, as approximate to the points of the greatest intensity of the magnetic force in the northern and southern hemispheres; St. Helena, as approximate to the point of least intensity on the globe, and the Cape of Good Hope as a station where the secular changes of the magnetic elements presented features of peculiar interest.

The committee recommended that the proposed colonial establishments should be placed under the general supervision of the Ordnance Department of the Army. The Government having expressed a desire that such extensive arrangement involving a considerable expenditure should be strengthened by the concurrent support of the Royal Society, a deputation was appointed to express the cordial participation of that society in the recommendation both of the Naval Expedition and of the fixed observatories. Arrangements having been completed, Lieut. Charles James Buchanan Riddell, R.A., was selected for duty in Canada, who, leaving his detachment, consisting of four non commissioned officers of the artillery, to embark with the instruments on a vessel bound direct to Quebec, proceeded himself to Canada by the more expeditious route of the United States; and having waited on the Governor-General at Montreal to present a letter of introduction with which he had been furnished by the Master General of the Ordnance, and communicated with the Commanding Engineer, to whom he was the bearer of instructions and authority to build an observatory, he proceeded to examine different localities which were suggested as convenient sites. The preference was finally given to Toronto, where a grant of two and a half acres of land belonging to the University of King's College was offered by the Council of the University. The first observatory building was of logs, roughcast on the outside and plastered on the inside; it was completed during the summer of 1840 and observations were begun in September. The operations of the observatory as an Imperial establishment were brought to a close in the early part of the year 1853, and were resumed under the authority of the Provincial Government in July of the same year.

In the autumn of 1853 the present observatory was commenced, to take the place of the old building. Very great care was taken during construction to insure all the stone used being entirely free from magnetism, and all nails and fastenings were of either copper or zinc. For twenty-three years the position of the Observatory was as far as is known, faultless, and observations were carried on systematically and carefully, and results given to the scientific world, which with those obtained under the old military regime, have made the Toronto Observatory famous in the history of terrestrial magnetism.

In 1876, however, trouble began with the building of the School of Science, which institution, however, being principally of brick and wood, caused but very small changes in zero values, which could be allowed for. Then followed a few years later electric light circuits which produced a change in the force instruments whenever the current was turned off or on, this difficulty was in part overcome by the Light Company courteously agreeing to arrange their wires in the vicinity of the Observatory in such a manner that currents should counteract each other. The next difficulty occurred when the addition was given to the School of Science, tons of iron being used in the construction of that building in an all too close proximity to the magnetic instruments, and much time and labor has been required to determine the precise effect of this "iron mine" on the various instruments. It was not, however, until the autumn of 1892 when the trolleys began to run that we began to suspect that sooner or later the Magnetic Observatory would have to be removed to another site.

The magnetic instruments in the Observatory consist of those brought out by Lieut. Riddell in 1840, of which eye readings have been taken six times each day, and of another set of similar instruments consisting of a bifilar for the measurement of the horizontal component, a balance needle for the vertical force and a declinometer, all of which record photographically.

Electric cars first ran in Toronto on August 17th, 1892; the line first put in operation was that on Church street, which was followed on September 5th by King street, between George street and Dufferin street. During

the first few weeks, while a very small vibration of the needle was discernible on the V. F. curve it was generally almost inappreciable, and it was not until September 20th that the movement increased to an extent sufficient to really impair the value of our magnetic curves; a marked increase of current must have been used on that day and afterwards. On October 10 the cars first ran on Yonge street, and there was only a very small increase in vibration, but a decrease of about .000070 of a dyne was observed when the current was on. About 10 a m., on the 14th January, there was a marked increase of vibration, and the vertical force increased about ·000200 one dyne. This disturbed period was only temporary, and shortly after 5 p.m. of the 17th there was a reversion to the smaller vibrations, which continued until May 15th, when very large vibrations began again and continued with varying intensity during the summer, while the decrease of the V. F. with the current ranged from about ·000200 to ·000500. This disturbance was very great between September 12th and October 17th and at intervals during the following year, but there was no radical change in conditions until December 17th, 1894, when a decrease of V.F. while the current was on, was changed to an increase, this occurring when the cars first ran on McCaul street. Throughout 1895 the vibration and amount of permanent deflection was very nearly as it has been since, but on October 15th the increase of V. F. with the current was again changed to a decrease, this occurred at the time that the railway company made certain changes in the feed wires. It is noticeable that although several changes occurred in the V.F., it at times having been less with the current on and at other times greater. The horizontal force showed a steady decrease on all occasions with the turn on of the current, which during the past two years has been ·000200 to ·000500. No appreciable deflection of the declinometer magnet can be noted, the only effect being a continuous vibration which has rendered the curves very ragged and difficult to read with accuracy.

A study of the traces during the times that the various electric lines were put in operation shows that with the currents ordinarily used there is little effect at $\frac{3}{4}$ mile, and a further survey with a portable instrument affords further evidence in the same direction; it has, therefore, been determined to remove the magnetic instruments to a point distant two miles from any probable trolley route and about nine miles from the present location, and continue what is certainly the most valuable and extended magnetic records outside of Europe.

NOTE.—The history of the establishment of the Observatory at Toronto is taken from the early reports.—R. F. S.

PROCEEDINGS OF THE THIRTEENTH ANNUAL MEETING OF THE ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS, AT PEORIA, ILLINOIS.

The Illinois Society of Engineers and Surveyors assembled in thirteenth annual meeting in the rooms of the County Superintendent of Schools, in the court house, January 26th. The executive secretary's report showed the society to have eighty-one old members in good standing, and during the course of the meeting twenty-two new members were added. After the secretary's report had been read, C. C. Stowell, president of the society, delivered his annual address. The report of the waterworks committee was presented by Dabney H. Maury, jr., chairman. This report gave information regarding the rules, regulations and rates of water companies throughout the State of Illinois. The secretary read a paper on "Railroad Construction in Mexico," by L P. Atwood, engineer of the maintenance of way of the Rio Grande, Sierra Madre and Pacific Railway. Mr. Atwood also presented a detailed account of the cost of steel tie plates used in the construction of this road. John T. Stewart, of Paxton, gave his experience as a leveler for the United States Geological Survey, in running lines in the Black Hills country. S. S. Greeley gave an interesting discussion upon the topic, "The Status of the Surveyor of Illinois; Is it a Profession or a Trade?" His conclusions went to show that surveying is one of the liberal arts; a profession, and not a handicraft or trade. He argued strongly for the licensing of surveyors and engineers, referring to the recent Act of the Legislature of Illinois requiring architects to be licensed.

The evening session, which was held at Bradley Hall, was given up to a description, with stereopticon illustrations, of the Peoria Park system, by R. R. Bourland, O. F. Du Buis and L. K. Dowein. The exercises were opened by an address of welcome by Hon. John Warner, mayor, which was followed by an address to the engineers by Hon. O. J. Bailey, president of the Polytechnic Institute. Before the opening of this session members of the society inspected the Bradley Polytechnic Institute. Thursday morning, Prof. Wm. D. Pence, of the University of Illinois, read a paper on the Graphical Representation of the Magnetic Declination, describing in a very interesting manner the daily and annual movements of the magnetic needle. P. C. Knight, chairman of the Drainage Committee, submitted his report on drainage and gave a description of the drainage of the Meredosia swamps in Whiteside county. Centrifugal pumps are used, having a daily capacity of 36,000,000 gallons of water per day with a lift of sixteen feet. An interesting paper upon the purification of sewage by the Ferozone Polarite System, as observed at Acton, England, was presented by John V. Alvord, Chicago. The discussion which followed the reading of this paper indicated that this system is to be adopted in the vicinity of Chicago at an early date. One of the most valuable papers which was presented to the society was on "Water Analysis," by A. W. Palmer, Professor of Chemistry at Champaign. Prof. Palmer being in charge of the sanitary survey of the waters of the State of Illinois, has much information upon this subject.

The afternoon of Thursday, the 27th, was devoted to an inspection of the Peoria water works plant and the Atlas distillery. At the evening session, Charles H. Nicolet, chairman, read the report of the committee on Municipal Engineering. A paper on Proposed State Supervision of Water Supply and Sewage Disposal was read by Jacob A. Harman. This paper gave a record of the efforts of the engineers and physicians of the State to have a bill passed providing that the State Board of Health should have control of the water supply and sewage of the State. The following officers were elected for the ensuing year: President, A. D. Thompson, Peoria; vice-president, W. A. Darling, Rock Island; executive secretary and treasurer, Jacob A. Harman, Peoria; recording secretary, J. C. Quade, Kewanee; trustees, W. D. Pence, Champaign; S. S. Greely, Chicago; C. C. Brown, Bloomington.

Friday, the 29th, the last day of the session, was devoted entirely to the reading of papers and committee reports and discussions. Prof. A. N. Talbot, of the University of Illinois, presented a report for the committee on paving brick specifications, and recommended that the society adopt certain uniform methods of testing. This report was finally referred back to the committee for further investigation to report at the next annual meeting. The first paper on the programme was "Deep Well Pumping," by E. E. Johnson, of Chicago. His paper gave very valuable data with reference to the air lift pumps and other systems of deep well pumping; he also exhibited a model of a new design of deep well pumping, which shows a great economy over any forms of deep well pump heretofore in use. S. S. Greeley, chairman, reported for the committee on the metric system, and a resolution was passed endorsing the adoption of the metric system for general use in the United States. Mr. J. E. Miller read a paper on "Brick and Macadam for Country Roads," describing work which had been constructed north of Monmouth, Ill. J. T. Schmeltzer, Mantino, read a paper on Improving the Roads of Illinois A most interesting paper on the road problem was that on The Improvement of Transportation in Country Districts, by E. E. R. Tratman, Chicago, resident editor *Engineering News*. A. Lagron reported for the committee on Public Highways, and showed a disposition to discourage action upon the subject by engineers because of the lack of interest exhibited by the farmers, or those who have most use for the roads. M. Huebinger, Peoria, presented a paper on City Map Making. After numerous resolutions, and installation of officers, the society adjourned.

AN Ontario charter has been granted to G B. Meadows, A F. Ede, Rose Ellen Meadows, May K. White, and T. Urquhart, Toronto, Ont; W. G. Meadows, Buffalo, N.Y., as the George B. Meadows Toronto Wire, Iron and Brass Works Company, Limited, to manufacture and deal in wire, wire-cloth, wire-fabric, wire goods, ornamental wrought iron-work, fencing, art metal goods, bank and office-railings, window-fixtures, display-stands, brass and brass goods, iron or wire-cots and bedsteads, elevators and elevator-coverings.

THE NEW WORKS OF THE TORONTO ELECTRIC LIGHT COMPANY.

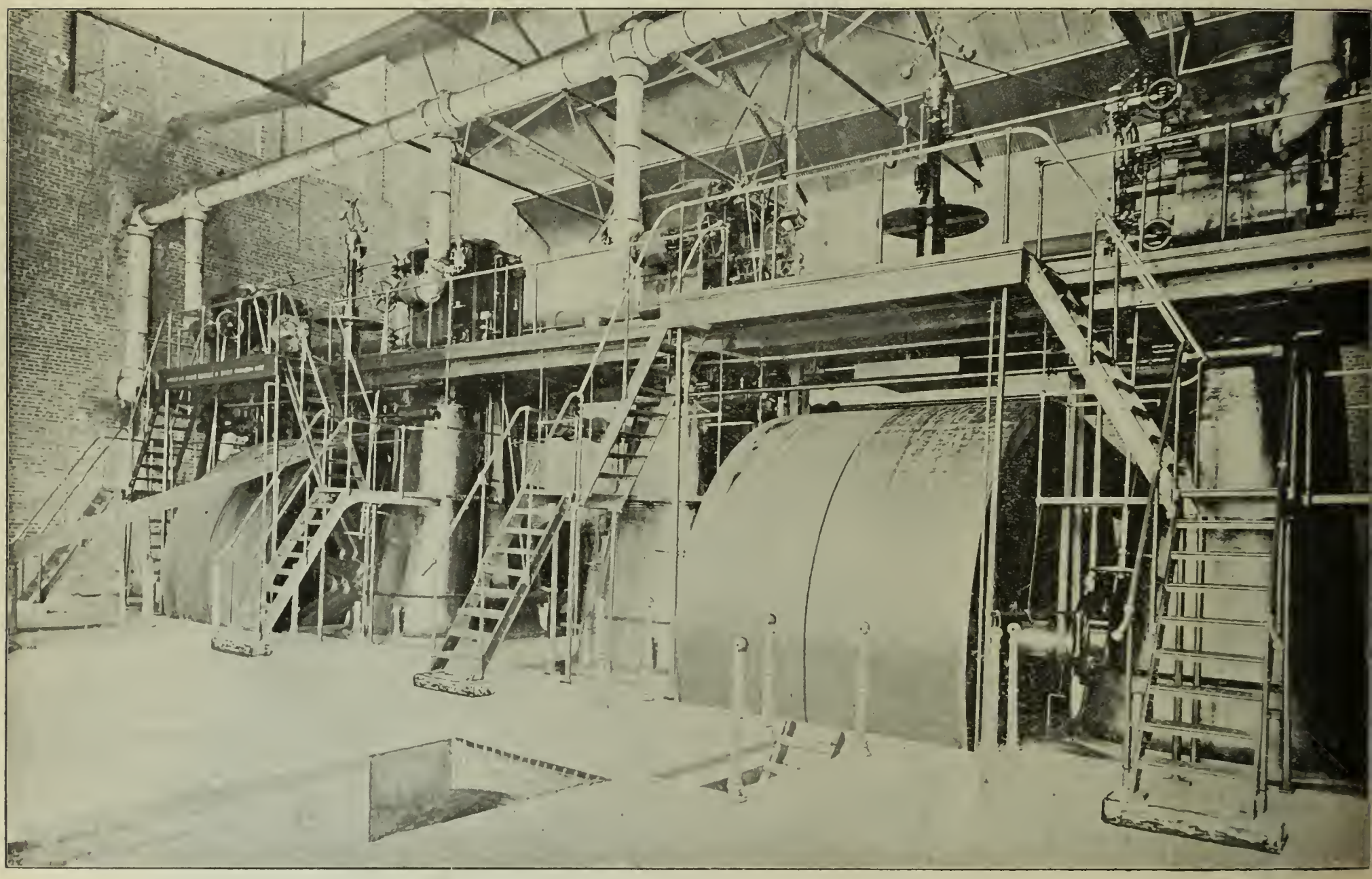
We are enabled in this issue to furnish our readers with some views of the new buildings of the Toronto Electric Light Company. It will be remembered that on the 21st of January last year, a destructive fire occurred, causing a loss of the arc lighting station of the company. Some effective work was done in providing temporarily for the illumination of the streets until permanent quarters could be provided for a new plant. The location of the works is one of the best that could possibly be chosen for a central distributing station. It is upon the water front of the city and at the foot of its principal thoroughfare and business centre. Unlimited water is available for condensing purposes and facilities for the unloading and storing of coal, both from cars and vessel, are of the best. In re-building it was determined to eliminate altogether the risk of loss and interruption by fire, and the new buildings are therefore constructed exclusively of iron, brick and stone. There is absolutely no wood used in their construction. The arc light station, No. 1, of which two views are shown, was completed about the first of September last, and is 165 feet in length by 68 feet wide. The foundation rests upon piles which were driven to the solid rock, and upon these a bed of concrete two feet nine inches thick was laid over the entire surface. Upon this the dynamos and engine foundations were build of hard brick and cement. They were raised high enough to permit of good head-room below, and the floor was formed of brick arches resting upon these foundations and upon I beams and iron pillars in the intermediate spaces. In the tunnels thus formed the driving shafts are placed. The dynamos are driven by belts passing through apertures in the arches to the floor above. There are in this building two compound condensing engines of 350 h.p. each, and two pairs of high-pressure condensing engines of 450 h.p. The shafting is all 6 inches in diameter, and runs on self-oiling bearings, being driven from the engines by triple leather belts 38 in. wide. A twenty-ton traveling crane is constructed to cover the entire floor space. This has been of the greatest value in placing the machinery in position, and when repairs are required, will be able to handle the heaviest piece of machinery at a minimum of both time and expense.

THE SCOTT STREET POWER HOUSE AND DOCK OF THE TORONTO ELECTRIC LIGHT COMPANY, LIMITED.

The arc light switchboard, which extends across one end of the building, is somewhat unique in both its methods and construction. It is built of pressed brick, with terra cotta facings. The terminals of the circuits are mounted on glazed tiles let into the face of the work. Ampere meters for each circuit are also mounted on other glazed tiles, and are large

enough to be seen from any part of the building. It is not necessary for the attendants to go to the switchboard, but they can see the state of the various circuits at any time, and wherever they may happen to be. Behind the wall constituting the board is a slate shelf, extending the entire width, to accommodate a standard ammeter or other testing instruments, which can be plugged in any circuit at any time by means of spring-jacks in each line. In each line also is a polarity indicator to ensure the correct direction of the arc lighting currents. The whole is surmounted by an electrically-driven cock, also built of brick, with a dial 6 feet in diameter.

Immediately adjoining this building, and forming the front premises, as seen at the left-hand of the engraving, is another fire-proof structure, which will be used as store-rooms for all kinds of supplies and show-rooms for incandescent fixtures, etc., and a completely fitted up meter department having all the latest appliances for repairing, reading and testing the various kinds of meters in use in the business. No. 1 boiler-house has re-erection. It is now a frame iron-clad structure, lined inside and on all the joists and timbers with sheet-iron. It is intended to replace it as soon as the weather permits with an iron and brick structure to match the others. The foundation work is now all completed and ready for the walls. As it is proposed to replace the building without interfering with the operations going on inside, considerable ingenuity will have to be exercised to avoid stoppage of the machinery for any considerable length of time. The building contains a double upright tandem condensing engine of 1,000 h.p., besides dynamos of all classes, arc light alternating and direct-current power machines, besides a pair of 110-volt machines that are supplying the underground mains of the Edison system in conjunction with the generators at the Teraulay street station of the company. At one end of the building is located the general switchboard controlling the entire output of electricity for all purposes. One attendant thus has under his hand the output from all the buildings except the arc light.



3,000 H.P. Engines in No. 3 Station, Toronto Electric Light Co

also been re-built, and has an iron roof with swinging sash for light and ventilation. This boiler-room contains three Heine water tube boilers of 250 h.p. each, and 10 return tubular boilers of 120 h.p. capacity each. No. 2 boiler-house, opposite, has two 250 h.p. Heine boilers, and two 250 h.p. Caldwell water tube boilers, with capacity for as much more.

Station No. 3 is a handsome fire-proof building, with iron roof and stained-glass windows. It is used for production of electricity for motor power and incandescent lighting. It contains two pairs of vertical Corliss engines of from 1,000 to 1,500 h.p. each. These are shown in the engraving. At the time the views were taken the ornamentation of the building was not completed. The brick walls which are shown bare, are colored a cream tint, with chocolate-colored dado and frieze. There are four dynamos only in this building, but they are machines of great capacity. Two of them being direct current 250-volt generators of 500 kw. each, and two double armature alternators of 450 kw. each. The air pumps of these engines are driven by independent Corliss engines, and make a very complete and satisfactory arrangement. The dimensions of this building are 80 feet by 68 feet.

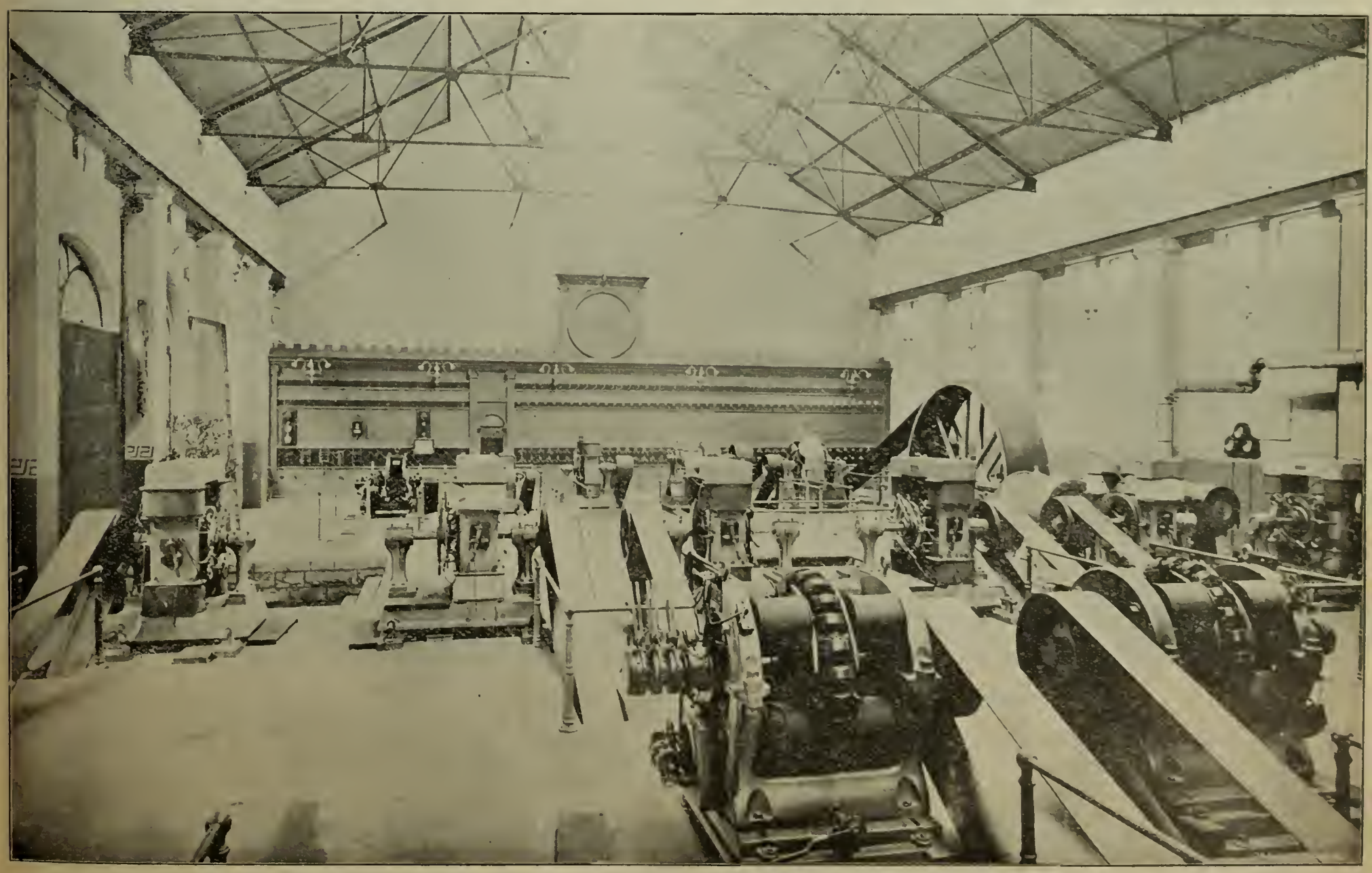
Station No. 2, which is the building immediately in rear of the offices, shown on the right of the view, is now in course of

At the further end of the lot is a spacious wharf on which will be erected for the opening of navigation an extensive coal storage plant and electric hoist for unloading vessels. Adjoining this are the stables with accommodation for 30 horses, linemens' quarters, lamp inspectors' and trimmers' room, carpenter shop, store-house, blacksmith shop, and a commodious machine shop, where a large amount of manufacturing is being carried on, as well as all the repair work necessitated by the operations of the company.

When the contemplated improvements are finished, the entire installation will be one of the most complete and up-to-date to be found in the country. The entire work of re-building has been done by day labor by the employees of the company, even to the construction of the iron roofs. The design and execution of the various works are creditable to the management and the efficient staff having charge of the varions branches of the work.

While the air is charged with rumors of so-called "cheap power" and various schemes, "fake" and otherwise, are being promulgated, the Toronto Electric Light Company are steadily proceeding with their developments. They are, it is claimed, producing power at the present time quite as cheaply as it can be transmitted from Niagara or any water-power, and the con-

Engine End of No. 1 Arc Light Station, Toronto Electric Light Co.



Switchboard End of No. 1 Arc Lighting Station, Toronto Electric Light Co.

templated installation of coal-handling apparatus to further reduce the cost will enable them to compete with electricity produced from any source. The rate at which power is being sold in Toronto, namely, 2 cents per horse power hour for 10 h.p., is said to be the lowest on the Continent of America to-day from a plant of a similar nature.

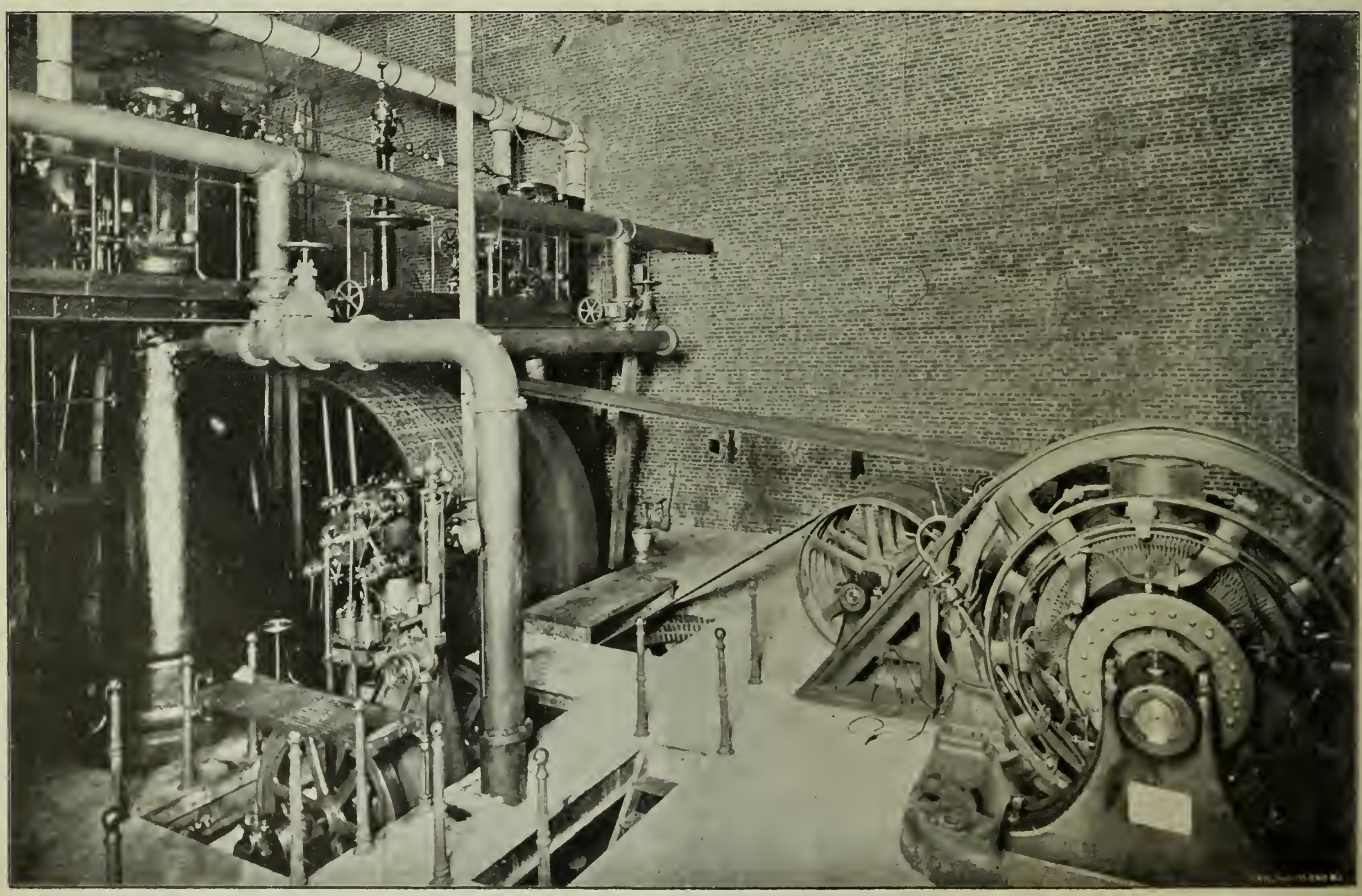
J. J. WRIGHT.

J. J. Wright, manager of the Toronto Electric Light Company, whose name is very well known in connection with the development of the electric lighting industry in Toronto, is one of the pioneers in the business of producing electricity for industrial use. He was born in Yarmouth, England, in 1850, and was educated at Shireland Hall, near Birmingham, and subsequently served some years at mechanical engineering. His father was a minister of the Methodist Church in England, but as he died while the subject of our sketch was but a youth, there were no ties to bind him to the Motherland, and Mr. Wright, like many others, in the early seventies struck out for the New World and landed in Canada some twenty-seven years ago. He went to Philadelphia at the time of the Centennial Exhibition of 1876, at which time electricity was beginning to attract attention as a commercial possibility. He there became acquainted with Professors Thomson and Houston, then members of the faculty of the High School at Philadelphia, and constructed for them some of the earliest experimental dynamos, crude enough in themselves, but the embryos from which have sprung some of the brilliant results of to-day. Mr. Wright constructed some of the first lamps used for street illumination, and was among the first to handle electric light wires in the construction of under-ground service, having constructed a line of under-ground wire for electric lighting in Market street, Philadelphia, between the City hall and Fourth street, in the year 1881. He was a member of the Franklin Institute of Science and Arts, and also a member of the National Conference of Electricians, convened by the United States Government.

In the spring of 1883 Mr. Wright returned to Canada and commenced the construction of the first plant for the distribution of electricity in this part, if not in the whole of Canada. It was located near the corner of King and Yonge streets, Toronto, and was the nucleus from which has sprung the extensive electric lighting interests of the city of to-day. When the Toronto Electric Light Company was organized the original plant was absorbed in the new company, and since that time Mr. Wright has filled the position of general manager. He has been three times elected president of the Canadian Electrical Association, and one of his most cherished possessions is a handsome gold watch that was presented to him at the close of his first year of office by members of the association.

Mr. Wright built and operated the electric locomotive that was for several years used at the Industrial Exhibitions in Toronto. This was the first electric railway in Canada, and during the years of its operation successfully carried many thousand of passengers. Mr. Wright was the recipient of an engrossed resolution and handsome testimonial from the Exhibition directors for the successful carrying out of what was then a new and untried service.

The design and construction of the new work of the Toronto Electric Light Company, which we illustrate in this issue, is Mr. Wright's latest work, and is one that has been most highly spoken of by more than one who is in a position to be a most competent judge.



DIRECT CURRENT GENERATOR, 250 VOLTS, 500 K W., TORONTO ELECTRIC LIGHT CO.

THE CHEMISTRY OF FOUNDRY PRACTICE.

BY ERNST A. SJOSTEDT.

Compared with the chemistry of the blast furnace process (in which the ores are deprived of their O., and the reduced metal combines with elements like carbon, silicon, manganese, etc.), and the different processes of iron and steel making (whereby the said foreign ingredients are oxidized and eliminated to a more or less complete degree), the chemical changes taking place in the cupola, where the metal is merely re-melted, are quite simple. Nevertheless, these changes, small though they be, are sometimes of great practical importance, and as the physical qualities of the castings (such as strength, hardness, elasticity, etc., are very largely dependent on the chemical composition of the metal, it is evident that the adaptation of chemical researches in connection with the foundry practices are well deserving of a most careful attention. The importance and necessity to the blast furnace manager and the steel worker of applying chemistry in their daily practice has long been recognized; but it is quite recently that the services of the chemist have been called upon to help solving the many puzzling problems which the foundryman constantly encounters. However, his legitimate place and position is already well established at the larger foundries in the United States and in Europe, besides at such works where a specialty is aimed at (such as car wheels and malleable castings), and the smaller foundries are slowly following their example.

In the hopes of arousing some interest in this important subject also (in this country, and especially) among the members of this association, the following notes and facts are hereby presented as a nucleus for discussion, founded as they are on the best authorities, and in all essential parts having been found correct and a most valuable help to the writer, in connection with his labors and investigations as chemist at different iron and steel works. Even at the risk of appearing pedantic, the writer has aimed at making this treatise as elementary as possible, in order to interest those least familiar with the subject, and must therefore, ask of the well-informed members their kind forbearance.

As we all know, absolutely pure iron does not exist as a commercial product, for what we are working and dealing with is not a single substance, but an alloy, composed of a number of elements in different proportions, the total sum of which, however, seldom exceeds 5 to 10 per cent. Among these elements, carbon is an essential constituent, and one that plays a most important role in determining the physical character of the iron. In fact, its influence on the iron is so great that its presence in smaller or greater amounts is responsible for the three well-known classes—with so distinctly different characteristics—in which iron has been divided, namely, wrought iron, steel and pig-iron: pig-iron containing about 2.5 to 5.0 per cent. of carbon, steel, from .4 to 2.5 per cent., and wrought iron, from about .03 to .35 per cent.; and their characteristics are so familiar to us all that it is here only necessary to recall their different melting points, which for pig iron is from 1,800 deg. F. to 2,200 deg. F., for steel, about 2,650 deg. F., and for wrought iron, about 2,880 deg. F. Again, we must carefully keep in mind that carbon, in pig iron, occurs in two conditions which are distinct in their physical and chemical relations, namely, as graphite and as allotropic modification, combined carbon. If present as graphite (i.e. simply mechanically mixed with the iron), the pig has a gray, soft fracture, but when in chemical union with the iron, the fracture is white and hard, with metallic lustre. In molten pig iron all the carbon is present in its combined form, and it all depends on the time and conditions allowed during cooling, which state—graphitic or combined—it will assume in the casting; the slower the cooling is taking place the better opportunity the carbon will have to crystallize (forming graphite), and the grayer the iron becomes; whereas, if made to cool suddenly (as when poured against a chill block) the carbon is not given this opportunity, and consequently, it is retained, more or less, in its combined state, and the iron becomes hard and white—always provided no other strong agent is present that will break this rule, and of which we will speak presently. The carbon, per se, as long as it remains combined in the pig iron, increases the absolute tensile strength of the iron, but when separating as graphite, it makes the iron weaker, it also increases the hardness, but decreases the elasticity and the melting point of the iron (i.e. white pig iron is somewhat easier to melt than gray). The following analyses of combined and graphitic carbon in a certain coke iron (Embreville, Pa.), will give a clear idea of the influence which the different modifications of carbon exert on the fracture of the pig:

	Per cent.			Per cent.
No. 1 foundry pig.....	3.80	graphite and		.10 C.C.
No. 2 foundry pig.....	3.78	"	"	.25 "
No. 3 foundry pig.....	3.60	"	"	.39 "
Gray forge	3.00	"	"	.70 "
Mottled	1.50	"	"	1.70 "
White	.10	"	"	3.10 "

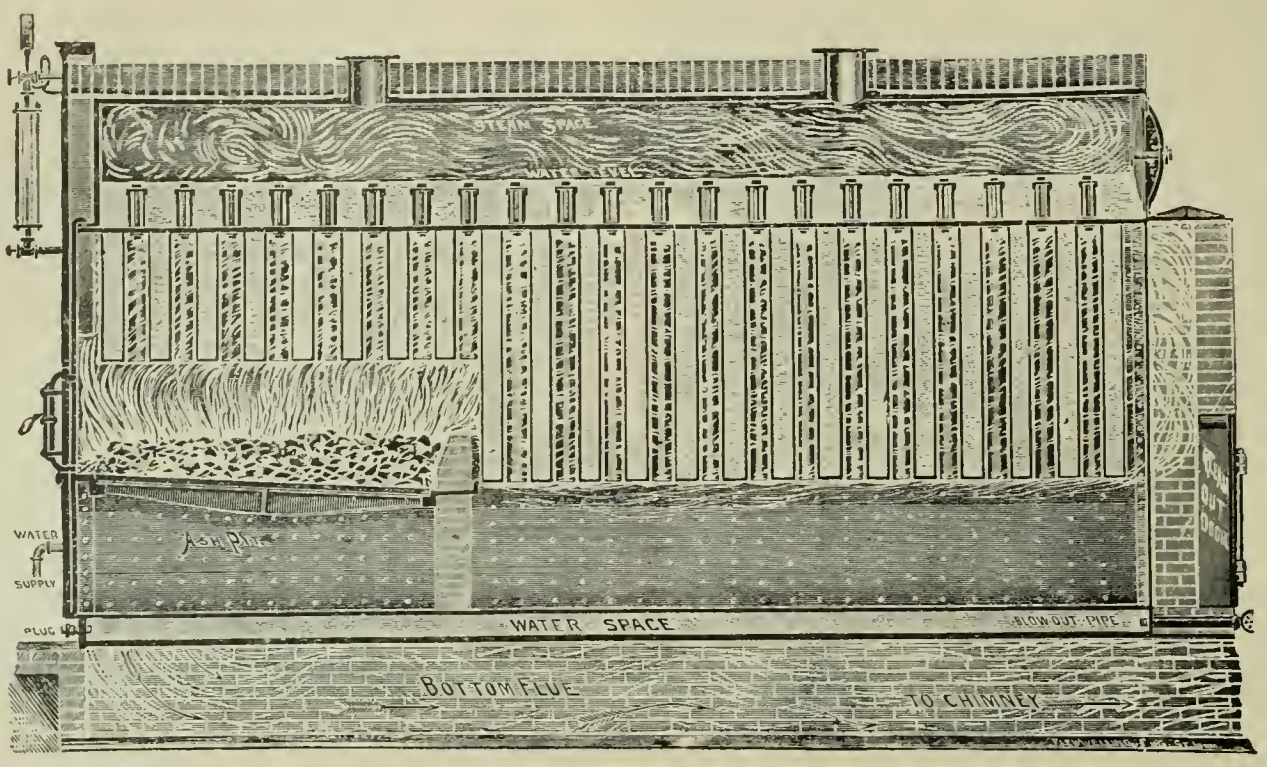
Among the other elements usually present in the pig iron, and the one next to carbon in importance, as regards its effect on the iron, we must place Silicon. Silicon, namely, exerts a controlling influence on the chilling properties of the iron, owing to its tendency of separating the carbon as graphite. Its percentage in the pig iron is generally in proportion to the temperature at which it has been produced. Thus, a coke iron is higher in silicon than a charcoal pig, and varies from a few tenths of one per cent. (as in Swedish charcoal pig), to 1.5 and 2.0 per cent. (in iron usually suited for machine castings), and runs as high as 2.5 to 3.5 per cent. in good soft coke iron; and the "silvery iron" contains about 4 to 5 per cent. silicon alloys with iron in greater proportions than carbon (ferro-silicon contains 30 to 50 per cent. Si.), and decreases the absorption of carbon. Hence, coke iron is generally lower in total carbon than charcoal pig, and iron with 2 per cent. silicon and no manganese has seldom more than 3.8 per cent. C. It increases the fluidity and fusibility of the iron, and lowers its smelting point, makes the iron retain its heat for a longer time, and thus lessens the formation of blow holes, and decreases the shrinkage (in proportion to the amount of graphite that has separated). Added to "pure cast iron" it has been found to improve the strength of the iron up to 2.5 per cent., but above this amount it makes the iron weaker. From the above properties of the silicon it is easy to see why it is that pig iron which contains a high percentage of silicon acts and is used as a "softener," and that by melting various portions of such iron with hard iron, all the different grades can be obtained, from close to very open-grained soft iron. In re-melting pig iron loses about .25 per cent. of silicon, which should not be forgotten. Another disturber of the equilibrium in a pig iron is sulphur. Contrary to silicon, sulphur present prevents the formation of graphite, and consequently, it has a tendency of producing a white, hard casting: it also makes the iron sluggish and full of blow holes, sulphuretted hydrogen gas, causes red shortness, and increases the shrinkage. Besides, being generally irregularly distributed in the iron, sulphur tends to make an uneven, unreliable casting. For these several reasons sulphur has well been called "the foundry man's bane," and owing also to the hindrance it offers to annealing, it should especially be avoided in malleable castings, also in iron intended for car wheels. Sulphur has a great affinity for iron, combining with it at a lower temperature, and in any proportions, up to about 53 per cent., and as its evil effects are perceptible already at a fractional part of one per cent., it must be a matter of great importance for the foundryman to keep track of this element. As a general thing it is rarely found in a soft, open foundry pig—for its presence to any high degree would make the iron more or less close-grained or white—and this great enemy, therefore, is not always shunned as much as it deserves; but its presence in the coke, and sometimes also in the limestone, is certain to bring it in the casting, and thus it happens that a good iron often has been condemned when the fuel and the flux alone were to blame. Good Connelsville coke contains seldom over .6 per cent. sulphur, but at many a foundry 1.0 per cent. S. in the coke is not unusual; and if a basic change and a high temperature be not resorted to in the cupola the iron, in re-melting, will increase .2 to .5 per cent. in sulphur, which is sufficient to spoil it for most purposes, if the silicon be not present in sufficient quantity to neutralize its effect.

To be continued.

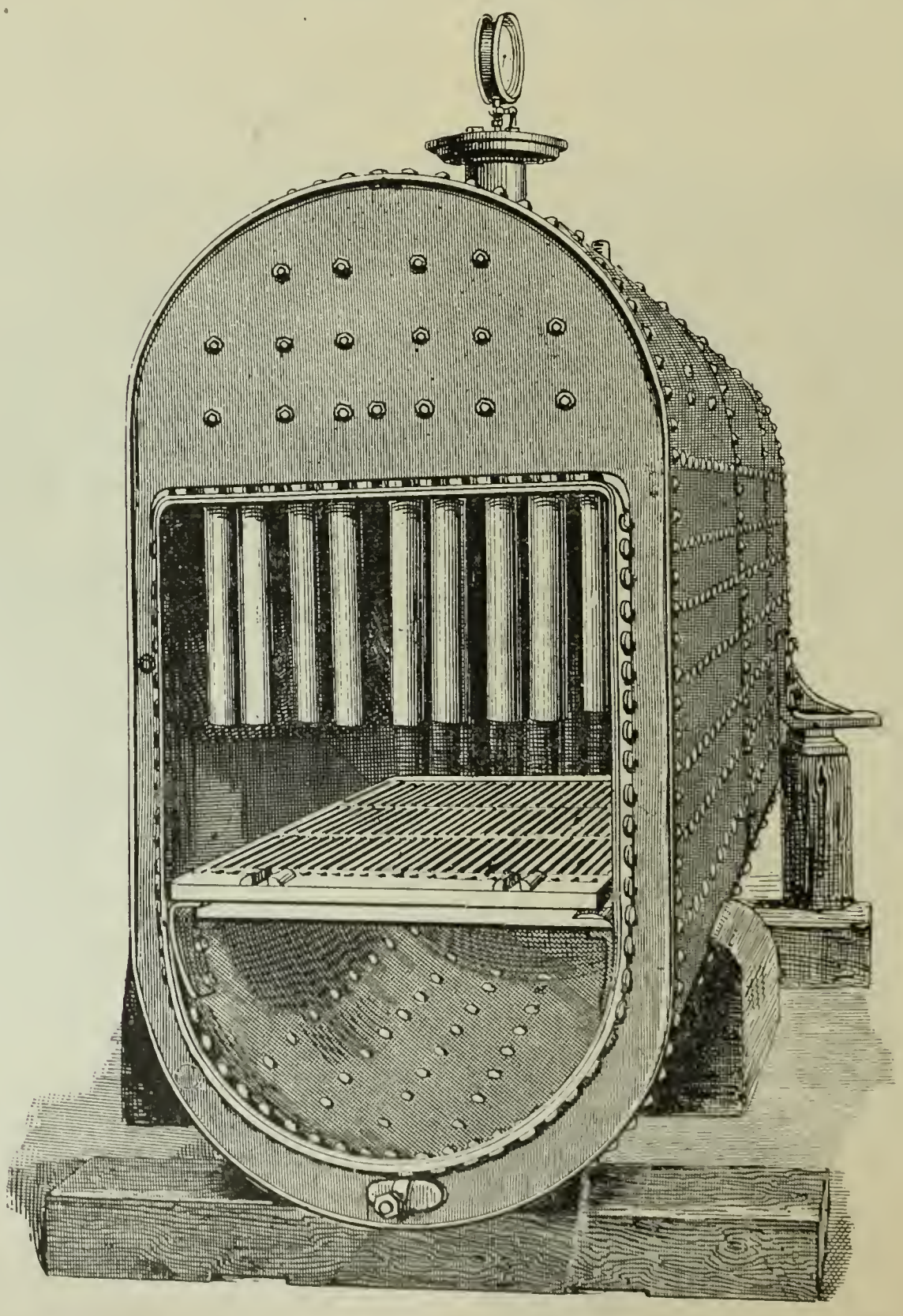
Two or three years ago marl beds were discovered near Orangeville, Ont., and D. B. Brown, T. M. Rowan, R. H. Gillespie, and J. M. Rowan have acquired 500 acres of land in the township of Caledon, within three miles of Orangeville, 400 acres of which contain a bed of marl, varying in depth from eight to twenty-one feet. The marl is pronounced to be particularly good, and suitable for making Portland cement, etc. It will likely be developed at an early date.

KINGSLEY WATER-TUBE BOILERS.

The Kingsley patent water-tube boilers, herewith illustrated, are constructed with two shells—an outer and an inner. The outer shell has vertical parallel sides and semi-circular top and boiler. The crown sheet is horizontal, and extends continuously the entire length of the boiler. It is flanged down three inches along each side for its entire length, and forms the top of the inner shell by being riveted to it along each side. The tubes are threaded at their upper ends with standard pipe



THE KINGSLEY PATENT DROP WATER TUBE BOILER.

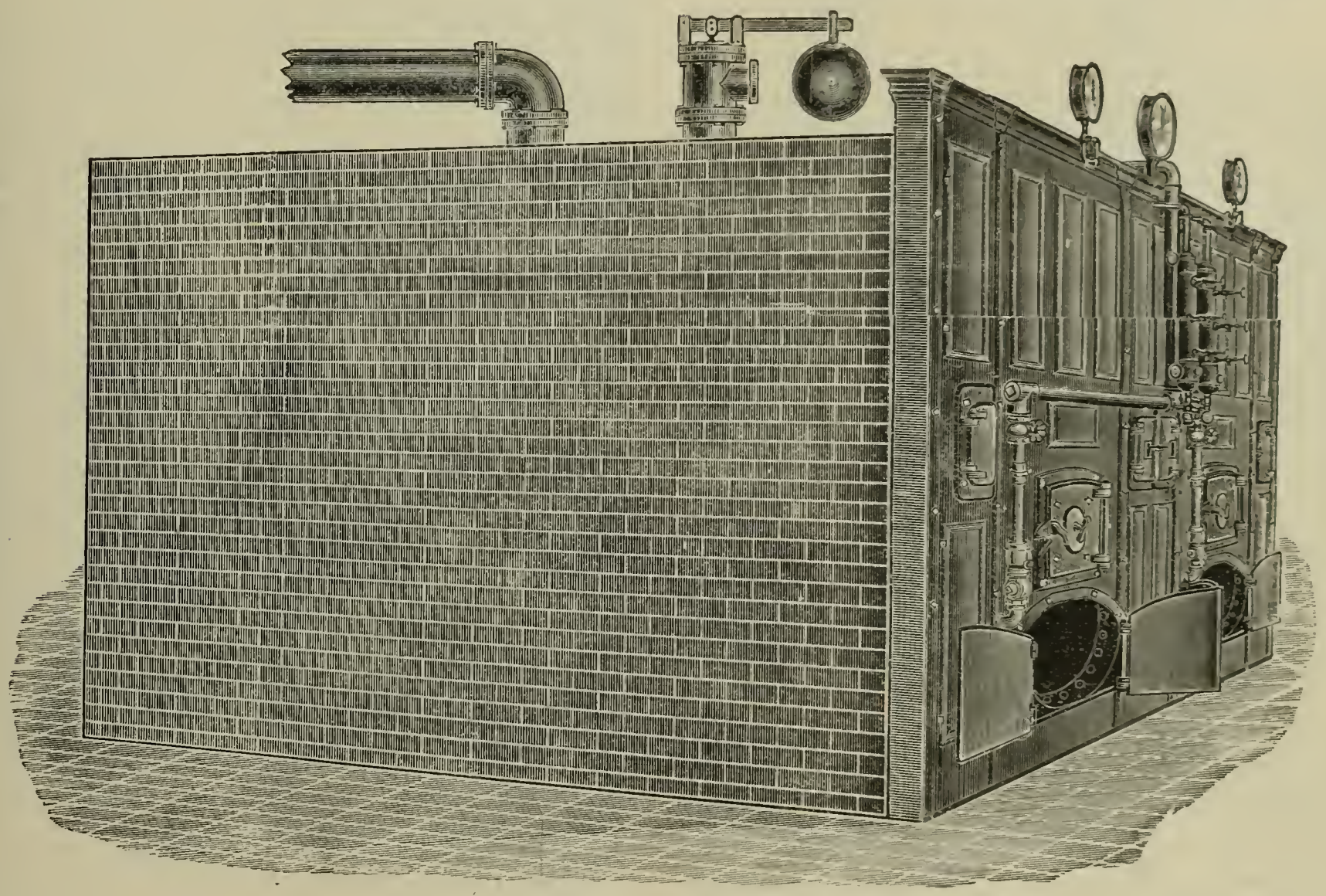


KINGSLEY BOILER—FRONT END VIEW OF NAKED BOILER READY FOR WATER TEST

bottom. The inner shell is fixed parallel to the sides and bottom of the outer shell, by means of two flanged heads and numerous stay-bolts, leaving a uniform space about four inches wide between the two shells extending the full length of the threads, and are screwed into the crown sheet. The bottom ends of the tubes are plugged with ¼-inch iron and are then welded solid. The tubes are made of standard 2-inch iron lap-welded pipe. They are short enough in the fire-box to leave

an ample combustion chamber, and are longer behind the bridge wall. Any tube can be readily screwed in or out of the crown sheet without touching any other tubes. The crown sheet is strongly stayed by stay-bolts, screwed simultaneously at various angles, into the semi-cylindrical top of the outer shell and into the crown sheet. These stay-bolts and those connecting the two shells are headed on each end. The parts of the two flanged heads forming the ends of the steam chamber are likewise stayed by rods screwed simultaneously into each, these rods being headed at each end or fitted with nuts.

The water is contained in the tubes, and in the space between the shells, and extends up a few inches over the crown sheet. As this water surface extends unbroken for the full length and width of the boiler, no rapid fluctuations of water level can take place, although the boiler is a very rapid steamer. It is possible to supply any capacity of water or steam space by extending the outer shell upward above the level of the crown sheet to any desired height. It is sometimes desirable to thus increase the steam space where large volumes of steam



KINGSLEY BOILER—REPRESENTING TWO BOILERS OF 150 H.P. EACH.

are required at one time, which occurs in various industries. No steam drum is used on these boilers. This is a great advantage over most water-tube boilers as well as many other types, as a steam drum elevated far above and away from the hottest fire can of itself act only as a condenser, as it is the tendency of steam to cool and condense immediately on leaving the direct action of the fire. In the Kingsley boiler the tubes, being vertical and short, liberate steam very freely, and without friction or impediment, which in all water-tube boilers with inclined tubes, causes a large percentage of water to be carried up with the steam. This is also one reason why this boiler produces dry steam even under the heaviest forcing. By those who have not investigated, an argument may be advanced regarding the deposit of sediment in the tubes. This, the manufacturers claim, may conclusively be answered by referring to boilers which have been in use for upwards of ten years. One of these in Chicago, being fed on the dirtiest of feed-water, has been in use for nine years. The users, a short time ago, wrote: "We have never had any trouble with the tubes filling with scale or sediment; but, on the contrary, we think they are brighter than new." Hundreds of tubes have been screwed out and examined for sediment, in various parts of boilers which have been running for different periods, and have been found perfectly clean; in fact, any scale formed in manufacturing the tubes appears to be loosened and removed by the ebullition and rapid currents when the boiler is under steam. After such investigations there can be no reasonable doubt on this point.

The reason for this exceptional cleanliness of the tubes is said by the makers to be clear when we consider the construction of the boiler. The feed-water, entering at the front of the boiler, between the shells, below the level of the grate-bars, in passing up becomes intensely heated before reaching the crown-sheet. It is well-known that water heated to a few degrees above the boiling point, parts with most of its impurities, as mud and carbonates of lime, and at a temperature of about 300 degrees Fahr., equal to 52 lbs. steam pressure, it can no longer retain in solution the sulphates of lime, magnesia, etc., which form the much-dreaded scale in boilers. In this boiler, these impurities being separated by the intense heat, precipitate into the space between the shells, at the bottom of the boiler, where the heat is not sufficient to bake them into scale, and whence they can be washed out occasionally through the hand holes. This boiler is, therefore, by its construction, stated to be a perfect feed-water purifier; and no sediment or scale can gather in the drop-tubes, because only purified water reaches the crown-sheet, from which the tubes are supplied.

The boiler, being internally fired, has the fire-box entirely surrounded with a water-jacket. The incandescent gases from the fuel, passing up among the short tubes in the fire-box, are drawn backward among the long tubes to the end of the boiler, whence they divide and return, half on each side, between the outer shell and the brick casing toward the front of the boiler. From this point the now nearly exhausted gases can either be carried by means of a saddle over the front of the boiler direct to the chimney, or they can pass down into a flue under the boiler along to its back end, and thence to the chimney. There is no appreciable difference in economy of evaporation between these two methods of circulation of the gases. The tubes are "staggered" in the crown-sheet and are spaced at such distances that the gases which pass zig-zag and strike each tube at right angles, while being confined on all four sides by the water-jacketed shell of the boiler, lose nearly all their available heat before they are returned on the sides. For this reason this boiler can be operated also as a locomotive boiler. The gases are passed out of the chimney only sufficiently hot to insure a good draft. This boiler requires the same size of chimney as any other type of boiler. For hot-water heating for buildings there is no change in the construction of the boiler, the steam space being simply filled to the top with water. The fuel

economy is the same as for steam purposes. The circulation of the water is the most direct that can be desired, as there is a continual uninterrupted rise from bottom to top of the boiler. For marine purposes there is no change in the essential design of the boiler, the difference being in details and setting, as the brick casing could not be used. It has been installed for the highest pressures, and is as easily cleaned and as durable as any boiler made. The economy of installation is apparent when we note the claim that this boiler occupies one-third less ground area than the other ordinary types of horizontal water-tube boilers, or the return-tubular boilers, and less than one-half their cubic contents. It requires only 6½ feet in height. The brick casing is used only for the return gases, and hence never requires renewing. As there is no firebrick furnace to renew periodically, the repairs are reduced to an absolute minimum. It is not necessary to refer to the exceptionally high evaporative economy of this boiler, as this could be readily predicted from its construction.

THE BARREN LANDS OF CANADA.

On a recent Saturday afternoon J. B. Tyrrell, of the Dominion Geological Survey, Ottawa, lectured to a very large audience in the Biological Department of Toronto University, Toronto, on the timely and interesting theme, "The Possible Resources of the Barren Lands of Canada." Introducing his subject, Mr. Tyrrell said that Canada was just now face to face with problems particularly her own. Reports of the fabulous wealth which reach us from the Yukon and elsewhere in the Dominion are naturally followed by the question: Are our young men being equally well trained for going out to the forest wilds to possess this wealth, as they are for other occupations in life? Continuing, Mr. Tyrrell deprecated the prevailing idea that a trifling knowledge of rocks and minerals is all that is necessary for the equipment mentally of young men going out to the gold and other mineral fields. Ignorance, he said, emphatically, means loss and failure in the locating of mines and minerals. Who would win in such search must be well trained. Only 10 per cent. of the great area of Canada is under cultivation at present; 35 per cent. only is capable of cultivation; there is a vast extent, roughly from about one to two million miles, which will not grow cereals, and which bears little or nothing. There are 750,000 square miles in which there are no fur-bearing animals, and which are rarely if ever visted by white men. These are known to the Indians as the Barren Lands. Of these there are 300,000 square miles in the Arctic Islands, 50,000 square miles in Northwestern Labrador, and 400,000 square miles west of Hudson Bay. Of these the lecturer said that he would consider the latter in his lecture, and try to show that there was every ground for hope that in the not far distant future Canada would have in these barren lands a sub-Arctic mining province, covered with comfortable homes, whose enormous wealth would in a great measure compensate the inhabitants for the rigor of the climate and other privations which are not known where nature is more kindly disposed. The barren lands of Northern Canada are three times as large as the British Isles, are bounded on the north by the Arctic Ocean and on the east by the west coast of Hudson Bay and Fox Channel. They are generally a vast undulating plain, broken by ridges, stony and bare, very flat for the most part, the grassy grounds covering a floor of soft creaceous shales and sandstones: a dreary, rocky, barren country. The highest point is reached in the Stony Mountains, which lie east of the Coppermine River, and are 1,500 feet above the sea level. The lecturer then went on to describe the inhabitants of these lands, who number 2,000 Esquimaux, whose pursuits are hunting and fishing, and 500 Chippewayan Indians, who retire to the forest for the winter. He described the animals, the principal of which is the Arctic caribou. Its flesh is excellent food for explorers and pioneers; it is here in countless numbers, and should it ever become extinct, it could be replaced by the Lapland reindeer. Other animals are the musk ox, which lives in the plains of the north; predatory animals are the white wolf, the wolverine, and the white bear. Whitefish and trout are plentiful in the rivers and lakes, and in the lecturer's expedition to these lands 124 specimens of plants were found. "But," said the lecturer, "it is to the mineral of these lands we must look for any real contribution to the national wealth." He then plunged into a very scientific description of the geology of the country, described the structure and nature of the rocks, showed that from Tobaunt Lake to Baker River there is a great extent of mineral-bearing rocks similar to the gold, silver and copper-bearing rocks on the north shore of Lake Superior, and in the Lake of the Woods district; he said that copper-bearing rocks extend along the Arctic boundary, and that there was every evidence to show that similar conditions existed in the numerous adjacent islands; indeed, there were many thousand square miles of these lands plentiful in copper; so plentiful were the evidences of this mineral that the lecturer thought that the barren lands will be as productive as Michigan. Besides copper and lead, gold, silver and nickel are there, with iron in enormous quantities; in brief, the lecturer had collected abundant evidence to show that there is a great natural wealth in the barren lands of Canada, which can now be reached with little trouble and expense. Ocean steamers can sail to the head of Chesterfield Inlet, which is open three months of the year; south of Chesterfield Inlet are good harbors, from which the Huronian rocks may be explored. Still further south, Fort Churchill is an excellent land-locked harbor, open for five months of the year, from June till November. The Hudson Bay steamer runs from London to the harbor. In every way Mr. Tyrrell thought that these lands were worthy of exploration and settlement; they are easily accessible, and the climate is not too rigorous in winter; and that their vast wealth now locked up will yield splendidly to work and enterprise.

Mr. Tyrrell's lecture was well illustrated by photographs, which were taken during his expeditions to the barren lands. When thrown upon the screen they gave a very good idea of the nature of this country, its inhabitants, animals, lakes and rivers.

MECHANICAL DRAWING TOOLS.*

By S. J. Ireland, Principal of Hamilton Art School.

Many parents have the mistaken idea that by getting a cheap set of drawing tools for a boy as a present they are creating in him an incentive to the study of art. A cheap case of instruments has been the means of spoiling many a boy's ardor for drawing. I have before me two cases of drawing instruments. One of these cases costs but $1.50; the instruments in this case have their points rounded, and their joints can be opened to permit cleaning. For a cheap case this is very good. The other case costs from eight to ten dollars, but as far as the merits of the instruments are concerned, I would rather have the first. Everyone knows what a pair of compasses is and what used for. The cheapest kind have brass cheeks and heads, but it is a well-known fact that brass rubbing on brass causes too much friction. Another kind has double cheeks, and is known as the hair divider. Most compasses are of English make, and these instruments appear to be made to last forever. The instruments made by the Germans, with exception of those made by one firm, are practically useless. But this one firm which is the exception makes the best instruments in the world. The best English compass is known as the Sexton joint. Compared with the German, the English compass is heavy and lob-sided, while the German instrument is finely balanced, easier to handle, and is superior to the English compass in the joint.

Pencil drawings must be inked in. Pens form one of the chief features of the draughtsman's outfit. A pen with both points bent inward should be thrown aside. The screw must not be so near the handle as to leave the ends too long. If overcharged with ink, a pen of this kind is apt to blot. The German pen has short ends and a registered screw. The time saved by the use of this pen is considerable. I have here a pen by the use of which circles and curves can be made without the aid of a ruler. For the finest work a spring point is used. This instrument has not been improved on in the last forty years. The Germans produce a very fine instrument of this kind with which you can take a measurement to the three-hundredth part of an inch. The cost of this instrument is $4.85. The German rotating compass has never been successfully imitated by the English or Americans. An instrument is now made for making dotted lines; it does fine, regular work, and is the means of saving considerable time. For making larger circles a longer radius is required. In the old English beam the pencil point and the point on which the pencil rotates are both of the same length, while the German beam has the advantage of having the pencil point shorter than the other by

*A Paper read before the Hamilton Branch, C.A.S.E.

the thickness of the drawing board. A dotting machine is also made to be used in connection with the beam. Protractors are used when the drawing is so fine as to be measured by degrees, minutes and seconds. All lines drawn on a level surface should be done with the aid of a "T" square. The best kind of these squares are those having an inclined edge. The best set squares are made of hard rubber. The slide rule is of great importance to every class of the community, but very few know how to use it. There is no arithmetical calculation known that cannot be solved by the use of this instrument. More can be done in five minutes with this rule than can be done in five hours or five days by arithmetic and algebra. A book on the use of the slide rule, written by Riddell, may be found in the Public Library in Hamilton.

THE FEDERATED CANADIAN MINING INSTITUTE.

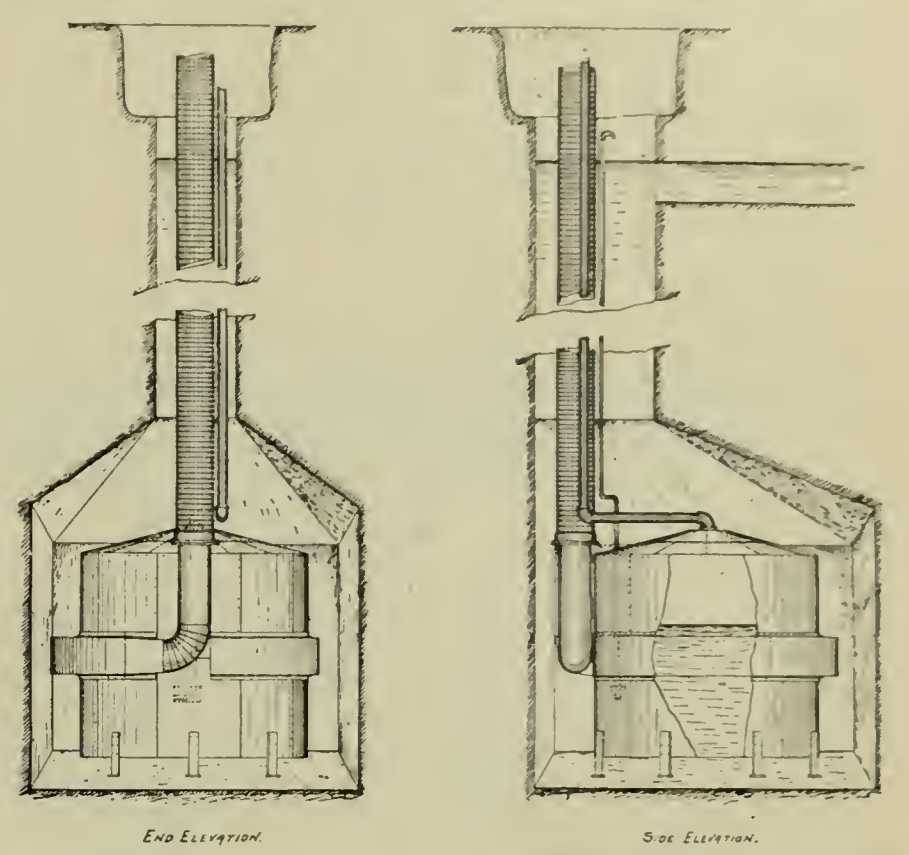
The second conference of the Institute opened in Montreal on March 2nd. As the meeting was held so near our date of publication, we are unable to give a full report of the proceedings. Considerable discussion took place on the effort made by the Canadian Society of Civil Engineers to become members of that association before practising in Canada. The Institute was resolved into the Canadian Institute of Mining and Metallurgy, a constitution being adopted. The Institution passed a resolution condemning the export duty on nickel mat. J. E. Preston, McGill University, read a paper on "Notes on the Ventilation of a Deep Metal Mine as Affected by Seasonal Changes of Temperature," at the evening session. This was followed by "Cableways as Applied to Open Pit Mining," by Spencer Miller, C.E. F. T. Snyder read a paper on "Some Modern Forms of Milling Machinery," and John Birkinbine, Philadelphia, one on "Commercial Progress as Influenced by the Development of the Iron Industry." Hamilton Merritt's paper treated of the gold-bearing reefs and placers of Northern British Columbia, and W. L. Goodwin read some Notes on the Anaylsis of a Rare Mineral. The following officers were elected: President, J. A. Hardman; Vice-presidents, W. A. Carlyle, Victoria; Charles Fergie, M. E. Westville, Nova Scotia; John Blue, and Dr. G. M. Dawson, F.R.S.; members of the council: Nova Scotia, Henry S. Poole, Stellarton; Major L. G. Leckie, Clarence Dimmock, W. L. Libbey, British Columbia; J. P. Hobson, Canal Forks; F. C. Loring, Rossland; W. Blackmore, Coal Creek; and R. G. McConnell, at present of the Geological Survey. Ontario, Archibald Blue, James McArthur, Sudbury; F. T. Snyder, Keewatin; H. Merritt, Toronto. Quebec, G. F. Drummond, G. R. Smith; Penhill, J. Obalski, M.E., Inspector of Mines, Quebec; Treasurer, A. W. Stevenson, Montreal; Secretary, B. T. A. Bell.

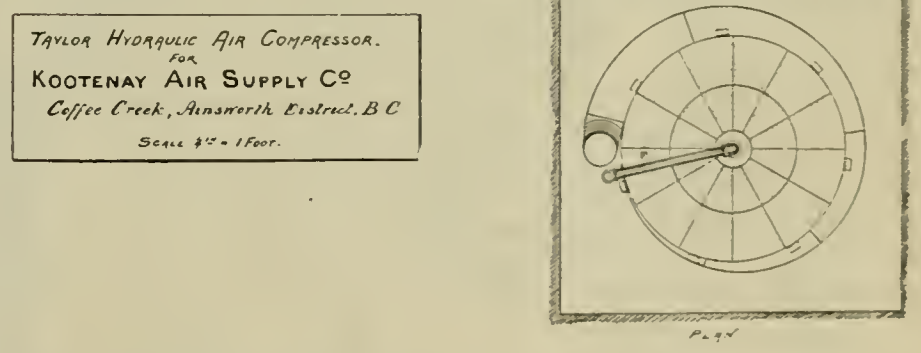
—F. J. Appleby, C.E., and J. J. Wilde have commenced business under the firm name of Appleby & Co., Room 501. Board of Trade Building, Montreal, as manufacturers' agents for bridge work, metals and rubber, mining machinery, tools, etc.

THE KOOTENAI AIR SUPPLY COMPANY.

The compressed air plant under the Taylor Hydraulic Air System, which is now being installed at the camp of Ainsworth, B.C , by the Kootenai Air Supply Co., is of such general interest to the mining world that a detailed sketch of the plant will be of interest to the numerous readers of The Canadian Engineer.

Ainsworth is the oldest working camp in West Kootenai. The ores are silver-lead in a very heavy formation, where the cost of development is quite high, and requires considerable power. The veins carry considerable water, and so far no great depth has been attained on any of the properties. There are several shipping mines in the district, and two concentrators. The point at which the Kootenai Air Supply Co. is installing its plant is on Coffee Creek, about two miles south of the heart of the district. The creek rises 25 miles back from Kootenay Lake in the high altitudes of the Slocan Mountains, and the stream is fed by a huge glacier. Like all mountain streams, the flowage varies abnormally, the lowest reading being about 2,500 cubic feet to a maximum of 8,000 or 10,000 cubic feet per minute. The high water period extends through the summer months, and until late in the fall, or during the period when a greater demand occurs for air. The creek has an average fall of 10 feet in 100, and the company is now building a dam across this creek five feet high, and a circular stave barrel flume, which has been sawed by the Salmo Lumber Co., the staves being 3 inches by 4⅛ inches, bevelled to the shape of a barrel five-eighths-inch round; iron bands, with take-up bolts will be used to hold the flume together, and these will be set every three or four feet on the flume. Joints are broken alternately in the wooden stave, a saw cut being made at the end of each stave, one-eighth inch thick and one inch deep, and a piece of iron of the same size is inserted to join the staves together. The lumber used is cedar, and the flume will be set on ties and wedged in place This form of construction is quite common on the coast, and a flume of the character in question will last longer than a light hydraulic iron flume, the lumber becoming water-soaked and practically imperishable. The total length of the flume is 1,354 feet, and the pressure on the flume will vary from 5 to 10 lbs., dependent on the height of the stream. This flume will cost complete with iron rods, exclusive of grading, about $1.25 per foot. The lumber is laid down dressed at $11.50 per M., lumber being exceedingly cheap in this section, while iron, owing to excessive freight rates, is very high.





The company is proposing to instal the receiving water tank and the down-flow pipe in wood, stave barrel construction being used throughout, so that the only iron in the plant will be the air chamber at the bottom of the shaft, and the ⅝-inch iron rods necessary to hold the flume and the down-flow pipe.

The head under which the plant will operate is 107 feet from the level of the water in the tank to the level of the water in the creek, and the back pressure of the rising water in the shaft will equalize the pressure in the down-flow pipe, so that the severest pressure at any point on the down-flow pipe will not exceed 60 lbs. The hoops will be put on at distances varying from 6 inches to 3 feet. The total depth of the shaft, which is now down about 90 feet, will be 210 feet, of which 20 feet at the base will be for the compression tank. In order to overcome the loss in the Magog plant due to ineffective separation, some slight modifications will be made in the construction of the Ainsworth plant, as will appear from the detail annexed. The down-flow pipe discharges its water into an iron inlet, which extends itself all round the centre or water line of the compression tank, and as the circumference of this tank will be approximately 51 inches, and the water with its corkscrew motion and its high velocity swings around this inlet, every particle of air carried down will be separated, so that the company's engineers figure on an efficiency of at least 70 per cent. of air h.-p. out of the gross h.-p. of the stream.

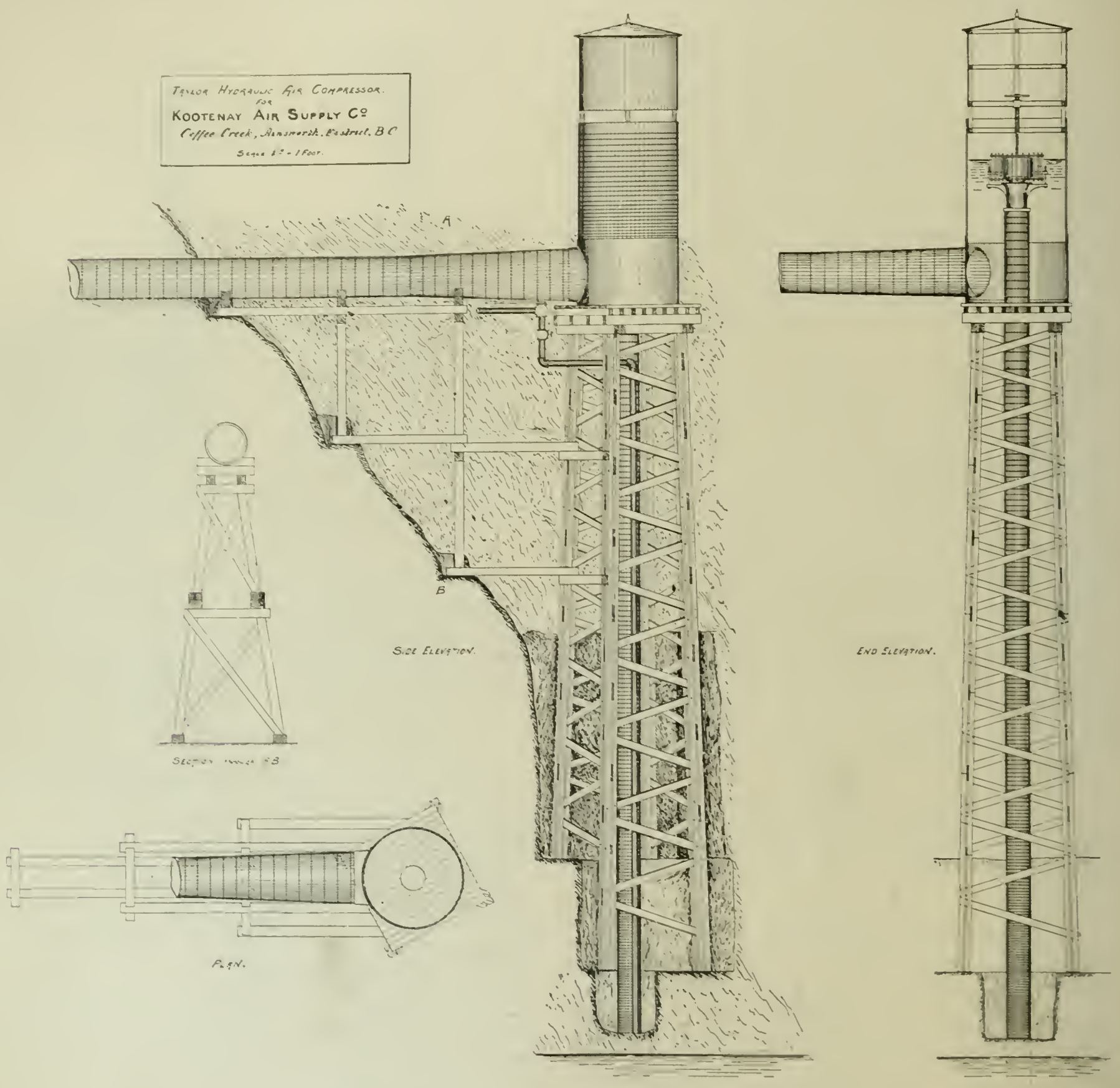
By the substitution of wood for iron in this work, the cost of the installation will be a moderate factor, and when the compressor outputs 500 air h.-p. the h.-p. cost of the air at the compressor site will represent a capital investment of only from $22 to $23. The h.-p. output of the compressor will vary from 340 h.-p., when the flowage is

2,500 c.f. per minute to a maximum of 650 h.-p. when the flowage is 4,500 c.f. per minute, the details of the plant being all worked out for the maximum flowage, which could be maintained throughout the entire year, if necessary, by the construction of further dam accommodation to store the water for the heavy load.

The company is now working 20 men sinking the shaft. The shaft is 6 x 8 feet in area, and a small boiler, 6 x 8 double hoist, and No. 2 Rand drill—all supplied by the Jenckes Machine Company—are now running on the work. The shaft is being sunk alongside the creek, and up to the present time, on account of the hardness of the rock, very little water has been met. Progress at the rate of about a foot per diem in sinking is attained, the cost being between $25 and $30.

Co. expect to sell power for the air drill on the 24-hour run at $3 per day, or less than the price of a miner's wage, and the mine owner will be saved all the capital cost of installing a compressor, with its attendant worry and cost of operation. Any prospector along the line of the pipe-line can tap on with a small pipe, and run a drill or a hoist, the capital cost of which is not very great, and when he is through with his work upon any particular property he can take up his outfit and move it to another claim. The power company, while able and ready to cut existing rates in two, will still make handsome profits, for with a drill rate of $3 (less than half the price of a miner's wage on the 24-hour run) the air h.-p. will still net, if from 20 to 30 drills are connected, between $140 and $150 per h.-p. per annum.

The estimated cost of the pipe lines laid on the ground is $18,000,



The main pipe-line of the company will be run from the compressor to some point on the "Black Diamond" ground, a distance of 10,000 feet. This pipe-line will be 9 inches in diameter in the clear, and with an initial pressure of 90 lbs., and allowing a loss of 10 lbs. in transmission, will discharge 4,600 c.f. of free air per minute, or, with 5 lbs. loss, giving a final gauge pressure of 85 lbs., will discharge 3,000 c.f. of free air per minute. From the "Black Diamond" ground branch pipe-lines will reach out to the principal operating properties in the district, and it is expected that with two miles of these branch pipe lines, varying in size from 3 to 6 inches, from 250 to 350 h.-p. of air can be sold. The pipe-lines will be of wrought iron, with bolted joints and rubber gaskets.

Throughout the Kootenay district the present charge for the air drill, consuming from 80 to 120 c f. of free air per minute, varies from $5 to $7 50 per day, dependent upon the size of the steam compressor plant and the fuel conditions prevailing. The Kootenay Air Supply

a portion of which, however, will be borne by the consumer, bringing the total estimated cost of the plant to $30,000. When once installed, the maintenance and operating expenses should be inappreciable. There is no moving machinery to wear out, no operators needed at the central station, and the life of the pipe-line is almost perpetual, as being laid above ground, it is affected only by atmospheric conditions.

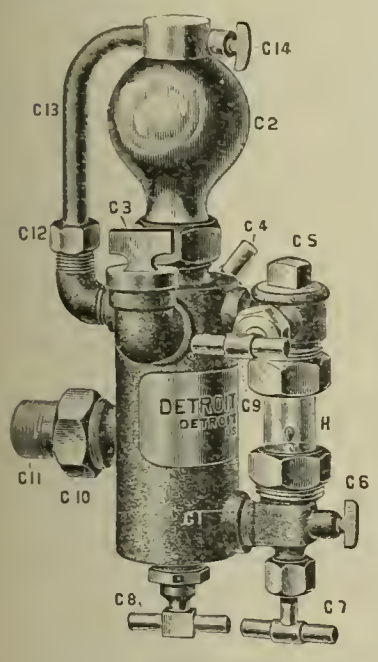
The greatest interest is being taken by miners, who are the largest users of air in the world, in this installation at Ainsworth. It means a vast saving in mining, for there are few mining districts throughout the entire West where a sufficient amount of water power is not available within from five to ten miles of mines to operate plants, and after the capital investment has been made the miner practically gets his motive power (and air is absolutely essential to him as motive power) without any cost other than the interest charge.

Steps are now being taken by the Taylor Air-Compressing Co., which is installing the plant at Ainsworth through its sub-company,

the Kootenay Air Supply Co., to make a similar installation in the Rossland and Ymir districts. In the former district some 750 actual air h.-p. are to-day being consumed, and the total cost of the air h.-p. at the mine to-day averages more than $200 per air h.-p. per annum. This section is one of the most inviting fields for the installation of a plant, the rock being especially hard, and the air power being absolutely indispensable for mining in the district.

A COLD WEATHER LUBRICATOR.

In the Northern States and Canada, where the winters are severe and of considerable length, it is often a difficult matter to maintain a steady feed of oil to the cylinders of engines. This is particularly true in the case of many mills and other steam plants where the engine room is exposed more or less to the cold. The oil thickens into a viscous, jelly-like mass, which will not break up into drops nor feed through the ordinary lubricator. As a result, the valves become cut and worn, and there is a double waste of energy due both to the cold and to the friction. Recently an ingenious lubricator has been designed by the Detroit Lubricator Co., of Detroit, Mich., to overcome these conditions. It is very appropriately called the "Zero," and is shown in the accompanying cut. Right above the support arm, inside the outer shell, is a heating chamber, which is always filled with steam while the engine is working. This steam heats the oil, and keeps it warm and in a liquid state, no matter how cold the weather. Of course, in very cold weather, it will use up some steam to keep the oil heated, just as it does to keep the cylinder heated, but the heat in the one case is just as positive as in the other. This heating chamber is perfectly automatic. In cold weather the steam in this heating chamber condenses more or less, and the condensed water runs back into the steam-pipe, keeping the chamber always filled with steam. These "Zero" cups have been on the market for nearly two years. They have been adopted by almost every American builder of threshing engines and by several Canadian ones. They are also used very generally on stationary engines that have to work in cold locations. Any one interested can obtain a descriptive circular or a complete catalogue showing them by dropping a card to the manufacturers.



ZERO LUBRICATOR.

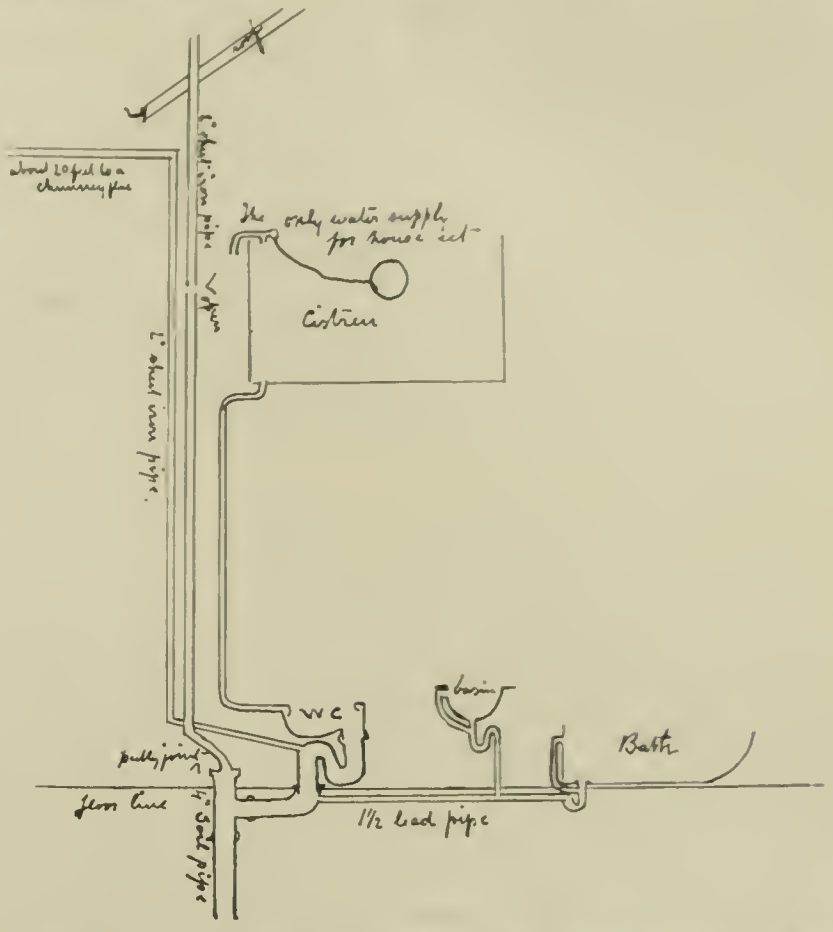
DANGEROUS PLUMBING.

Editor THE CANADIAN ENGINEER.

SIR,—In one of Toronto's large, well-appointed and handsomely furnished residences, a licensed plumber was engaged to remove an old pan water-closet, and the lead bend and P.-trap, and fix in a 4-inch by 4-inch tee in place of the lead quarter bend, and a 4-inch lead bend in place of the P.-trap, and an improved sanitary two-piece water-closet in place of the old pan water-closet.

The house had been fitted up in the first place in the old English style, having a large lead-lined storage cistern, from which the w.c. was flushed, and the range boiler and every water tap in the house was supplied. The cistern itself receiving its water through a ball tap and lead pipe direct from the city water mains. The old pan was vented by the 2-inch horn upward through the roof by a 2-inch sheet-iron pipe that dropped in two when the old closet was removed at the point shown in the sketch between the cistern and a wall having a space of about six inches jammed with about six different lines of pipes.

From the socket of the 4-inch to 4-inch soil pipe tee, the plumber fixed a 2-inch piece of sheet iron pipe up to within 1½ inches of the end of the old pan w.c. vent pipe at the end of cistern (see sketch), and there left it as a completed job, because one end was vertically under the other. By this, most of the sewer gas that should pass out through the roof is abstracted and absorbed by the drinking water stored in the cistern close by, which would partly poison the water and make it unfit to use for domestic purposes. And if not all absorbed by the cistern water, the balance would pass into the room, little if any would pass up the pipe except when the temperature of the room was lower than the outside. From the vent-horn of the new sanitary trap, he took another two-inch sheet iron pipe up and over the ceiling of room for twenty feet perfectly level to a chimney. He could have graded upward to a higher level of 8 feet if he chose. To expect air to circulate through so long and small a pipe laid level is absurd, and if it did deliver the sewer gas in the chimney at the point about 12 feet below the discharge head, it would not ascend upward except when the flue was warm When no fire was burning and the flue was cold the sewer gas would descend the straight flue into the living apartments.



The third error is seen by referring to the sketch at the point where the 1½-inch bath waste joins the heel of 4-inch lead bend. When bath pipes are joined in this way the excrement is liable when it bounces on the heel of bend to rebound back up the 1½-inch pipe, and charge the pipe, beside pressing the foul air in the small pipe through the water seals and by the act of making the water seal to oscillate to break the seal of the trap and leave it open until more water is run in.

This job has only been done within a few weeks time and one would hardly have expected to find such dangerous ignorance displayed, especially in a house where the total cost of good sanitary arrangements and workmanship would probably be only one-tenth of the amount of the house furnishing.

WM. WATSON.

567 King st. W., Toronto, Feb. 15th, 1898.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during January, 1896, 1897.

	January. 1896.	January, 1897.
Hardware and cutlery	4,765	1,636
Pig iron	380	504
Bar, etc.	1,236	285
Railroad	..	50
Hoops, sheets, etc.	1,840	827
Galvanized sheets	654	2,031
Tin plates	22,508	11,929
Cast, wrought, etc., iron	1,684	1,874
Old (for remanufacture)	191	..
Steel	2,586	4,521
Lead	519	978
Tin, unwrought	3,046	422
Cement	468	518

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

KINGSTON NO. 10.

A special meeting of Kingston No. 10 Canadian Association of Stationary Engineers was held in Congress Hall, January 26th, 1898. It was called for the purpose of visiting the members of Parliament, B. M. Britton for the city and David Rogers for the county, *re* legislation. The following members of the association were present: President Simmons, Vice-President Asselstine, Past President Donnelly, Bros. Hoppins, Blomely, Woodrow, Davis, Taudrein, Linton, Strong, Gascoyne, Selley, Derig, Bajus, Turnbull, sr., Tait and Orr. There were also present certificated members of the Ontario Association: David Leslie, P. McArdle, James Ross and George Hazlett, of the Winnipeg branch of the association. All of the above members formed a deputation and proceeded to B. M. Britton's office; when David Rogers arrived the business was proceeded with, President Simmons reading and presenting an address, along with a copy of the Act, to Mr. Britton, after which H. Hoppins, in a few well chosen remarks, pre-

sented a copy of the address and the Act to David Rogers. Both gentlemen replied. After a few questions were asked regarding the working of the association, which were answered satisfactorily by President Simmons, Past President Donnelly, Bros. Hoppins and Blomely, the question was put to Mr. Britton if he would support the bill. He stated he would, and more than that, if the party having the bill in charge wanted any help to get it in shape to go before the House, he would only be too happy to give him any help he could to make it a success. Mr. Rogers was then asked if he could support it. He said he could not see anything in the bill but what was right and just, but he would not pledge himself until he made further enquiries. The deputation retired, feeling satisfied that when it came before the House he would support it. At a regular meeting held on the 3rd February, there was a resolution made that a hearty vote of thanks be tendered to B. M. Britton and David Rogers for the reception they gave the deputation of engineers who waited on them, and also that a copy of the minutes of the special meeting be sent to THE CANADIAN ENGINEER for publication.

JOHN L. ORR, Sec.,
Kingston No. 10, C.A.S.E.

C.A.S.E., TORONTO, NO. 1.

C.A.S.E., Toronto, No. 1 held its regular meeting on Feb. 2nd. There was a good attendance and two initiations, and two propositions were received. There were several questions in the question box. Bro. Miln took them up and figured them out on an old door, the new blackboard not being finished. Bro. Miln also took up the question, "What Makes a Motor Go?" and his explanation was highly appreciated by all the brethren present.

Their regular meeting on Feb. 16th, was held in their hall, 61 Victoria Street. There was a fair attendance, and after the regular business was over, and the question box opened, it was found to be full of Scranton School questions, some of which were answered and some taken home by the brethren, to ponder over till the next meeting night, when they will be expected to work them out on the new blackboard.

At the regular second Tuesday evening open meeting, Feb. 15th, Bro. Wickens continued his talk on The Steam Engine Indicator, after which a hearty vote of thanks was tendered to Bro. Wickens.

At the regular meeting on March 2nd, Engineers' Hall, 61 Victoria street, there was a good attendance and one candidate was initiated. A number of questions were asked and figured on the blackboard by Bros. Past Presidents Fox, Moseley and Bannan, which work was greatly appreciated by the brethren present. A Legislative Committee reported that all the members of the Dominion Government present in Toronto had been written to, asking their support for the Engineers' License Law and Boiler Inspectors' Act, which is to come up at the present session, and a number of them have promised their consent.

The regular open meeting will be held Tuesday evening, 8th inst. Mr. St. John has kindly consented to give a talk on the strength of boilers. The president expects a large attendance, and invites all engineers to the open meeting. The members "do not want to keep all the good things to themselves."

—The annual meeting of the Canadian Press Association will be held in Ottawa, 10th and 11th inst. Among the important matters to be considered will be the postage question, insolvency legislation, and the visit of British journalists to Canada. Frank A. Munsey, who has been without doubt the most successful modern publisher, will deliver an address on and discuss the "Elements of Success in Newspaper Publishing." It is hoped that one or two of the following representatives of the British Institute of Journalists will be present: Lord Glenesk (London *Morning Post*), Sir Hugh G. Reid, M.P., J. M. Maclean, M.P., and Sir Edward Russell. The dinner will take place as usual, when a number of important speeches will be made.

—P. B. OWENS writes to a contemporary:—"In these days of enormous productions of iron and of stupendous commercial transactions, it no doubt will interest many of the present generation to learn that mining, smelting and manufacturing of iron was an established industry in the County of Essex, Ontario (then Upper Canada), in the early part of this century. A smelting furnace was built in the Township of Gosfield, on the farm of Michael Fox, about one mile north of where the Olinda post-office now stands. The ore was taken from natural deposits in the adjoining Township of Mersey, and the fuel used was charcoal produced in the immediate vicinity. The writer remembers how wonderful the furnace, the smoking stacks of wood covered with earth, and the sluice boxes for the washing of the ore all appeared to his childish mind. A large quantity of timber was consumed in the production of the charcoal, timber which, if now standing, would be of enormous value. But no kind of timber, except white oak, was then considered of any value, even black walnut being made into fence rails, and much of it actually burned up in clearing the land."

—The German Association for Acetylene and Calcium Carbide will hold an exhibition of the recent progress that has been made in this industry, and at the same time a congress to consider the various scientific and practical questions that have arisen in connection with it. The exhibition, which will be held in Berlin from March 6th to March 20th, will comprise acetylene generators, lamps, purifiers and mixing apparatus, acetylene burners, motors and soldering tools, calcium carbides, electric furnaces and electrodes, and the different varieties of machinery used in the manufacture of the calcium carbide. Rigorous regulations have been adopted by the Berlin police to prevent any premature explosions, and no generating apparatus using more than about one-half pound of the calcium carbide will be permitted in the main exhibition hall. The use of pure, compressed, or liquefied acetylene gas will be prohibited, and a limit of a hundred and twenty pounds pressure has been placed on mixtures of the gas. The use of acetylene gas for illumination is increasing, and the coming exhibition will show how general its application can be made, as well as the simplicity with which the gas is generated.

Industrial Notes.

THE St. Thomas, Ont., city council is looking for plans for the new city hall.

GEO. GRANT, Arnprior, Ont., has the contract for building a bridge at Burnstown, Ont.

CHAS. RITZ has bought the foundry until lately run by C. Ritz & Co.—*New Hamburg Independent.*

THE Grand Trunk Railway, it is stated, contemplate building a mammoth hotel in Quebec city.

D. RICHARDS & Co. speak of the erection of a steel and brick addition, 90 x 40 ft., to their soap factory at Woodstock, Ont.

A BY-LAW, under which Goderich, Ont., is taking $50,000 stock in the Elevator Company, has been carried by 416 majority.

J. WILSON, foundryman, St. Catharines, Ont., has received a large order for wire cables for mining in British Columbia.

THE Stellarton, N.S., Lubricating Company, we understand, intends shortly to commence the manufacture of their lubricant on a large scale.

J. R. ADAMSON, Cornwall, Ont., is one of the incorporators of the Black River Creamery Co., Limited, which intends building a factory at once. Capital, $2,000.

APPLICATION has been made for the incorporation of a company to be known as the Woodstock, N.B., Sash Balance and Lock Company, to manufacture and sell a patented window raising and locking contrivance.

THE residents of North Cypress, Man., are endeavoring to make arrangement for a bonus of $10,000 to a flour mill and elevator. The mill is to have a capacity of 300 barrels and the elevator 100,000 bushels capacity.

THE new agricultural hall at Shawville, Que., will cost about $3,000. The design has been made by architect Edey of Ottawa, and is for a building of octagonal shape, the dimensions being 99 feet diameter, and a 27-foot wall.

THE Knowles Bicycle Company, Limited., is applying for incorporation; chief place of business, Brantford, Ont.; capital, $50,000. The provisional directors are: W. J. Knowles, W. G. Nott, J. T. Ham, J. H. Ham, and Maria Knowles, Brantford.

A DOMINION charter has been granted to C. Guimond, Beauharnois, Que.; C. F. Lalonde, Montreal; J. Leduc, Beauharnois; J. B. Roy, Beauharnois; Delia Rochette, wife of Emilien A. Manny, Beauharnois, as the Star Iron Company, Limited, with a capital of $60,000.

FRED. H. DOUGHTY, formerly in the employ of Jas. McPherson & Co., Hamilton, Ont., has purchased the business of H. B. Livingston & Son, machinery agents, Leicester, Eng., and, with Mr. Livingston, jun., will continue the business under the firm name of Livingston & Doughty.

A PLEASANT event took place at the B. Greening Wire Company's works, Hamilton, Ont, on a recent evening, when the employees of the rope department presented the foreman, Charles A. Herald, with a set of drawing instruments. Louis Beck made the presentation, with a felicitous speech. Mr. Herald made a suitable reply, thanking his co-workers for the pleasant surprise.

W. BURROW, C. Stewart, J. Milne, J. Stewart and C. Milne, Hamilton, Ont., and W. Burrow, jr., Chicago, Ill., are applying for a Dominion charter as the Burrow, Stewart & Milne Company, Limited, to manufacture stoves, furnaces, scales and hardware generally. Chief place of business Hamilton, Ont.; capital, $250,000.

LONDON, Ont., wants an engine to run its stone crusher.

ST. CHARLES COLLEGE, Sherbrooke, Que., is to have a new building.

A ONE hundred thousand dollar block of buildings is to be erected at Victoria, B.C., by the Molsons Bank.

DESERONTO will vote on a $20,000 bonus towards a charcoal iron smelting works in that town, to cost $250,000.

PETER STEWART, Arnprior, Ont., has secured a position with the Wm. Hamilton Manufacturing Co., Peterboro, Ont.

THE contract for building the Simcoe county, Ont., House of Refuge has been awarded to A. Tessier, Penetanguishene, for $14,966.

THE New Brunswick Government has invited tenders for the extension of the breakwater at Centreville, N.B., estimated to cost $4,000.

THE Carleton Place, Ont., council has had a letter from the Perth Waterworks Co., Limited, asking for a similar franchise from that town as they received from Perth, Ont.

THE Lancaster Machine Works, Lancaster, Ont., are kept busy with orders in all lines, especially in their line of cotton mill machinery, in which they are building up a good trade.

A NEW single span iron bridge will be placed over the River Raisin, at South Lancaster, Ont., the coming spring, to replace the old wooden structure, which has been condemned.

THE London, Ont., Foundry Company has received orders for four carloads of wheelbarrows, forges and miners' tools, for shipment to the Klondyke. The order comes from a Vancouver firm.

THERE is every indication of a good dairy season during 1898, and manufacturers are preparing for it; already the Lancaster Machine Works have booked several orders for their patented specialties.

THE Nelson, (B.C.), Iron Works are employing 12 men at present. They make and repair machinery for the mines in the vicinity. They recently completed a contract for water hydrants for Grand Forks.

WE have received from the International Correspondence School, Scranton, Pa., a booklet containing some hundred testimonials from pupils all over the world, who have studied under its direction with much benefit.

THE Massalon Paving Brick Company, of Massalon, Ohio, is endeavoring to place its wares on the Canadian market. The Massalon brick is larger than any of Canadian manufacture, and is said to be one of the best made.

G. H. MCGILLIVRAY, township clerk, will receive tenders up to noon on the 19th inst. for the construction of two stone abutments on the site of the Lancaster bridge, South Lancaster. Tenders will also be received for concrete abutments.

THE stock and plant of the Beaver File Works, Levis, Que., was sold by auction a short time ago. The purchasers were Marcau & Jauteau, who have now decided to change the name, and in future the concern will be known as the Mechanics' Star File Manufacturing Co.

THE Moore & White Co., of Philadelphia, manufacturers of clutch pulleys, couplings, etc., have appointed the Lancaster Machine Works, of Lancaster, Ont., as their representatives in Canada, from whom all particulars regarding these justly celebrated friction driving devices may be obtained.

THE Hamilton, Ont., municipal estimates for 1898 contain the following large items, among others: Catharine street sewer, $22,000; Wood street (John to James) sewer, $3,700; trunk sewer, east end annex, $20,000; Aberdeen avenue sewer (Locke and Garthe) $3,900; disposal works, expense, $10,000; gully drains and ventilators, $2,500; Mountain drain improvements, $2,500.

THE Ingersoll-Sergeant Drill Company has issued a very neat booklet, which is practically a condensed edition of their catalogue of air compressors, It contains illustrations of the various types of compressors, and shows some of the uses they may be put to. Copies of this handy little volume may be had by applying by postal card to the Montreal office, 299 St. James street.

G. W. RICHARDSON, representing the proposed Rossland, B.C., Gas Company, asks the following concessions from the municipality: The right to construct and operate gas works and to supply gas to the citizens of Rossland for ten years, with the right to lay mains and service pipes along the streets of the city; gas to be of a standard not less than 16-candle power, and to be supplied at a rate not more than $2.50 per thousand feet; work to commence in six months and to be completed within two years; gas to be supplied to the city at $3 per month per light, if 25 lights are taken, and $2.50 per lamp if more than 30 lamps are used; corporation to have the privilege of purchasing the plant at any time within ten years at a price to be decided by arbitration.

J. HANBURY, Brandon, Man., is negotiating with the municipality to start a wood-working factory. The proposed building is to cost $20,000.

W. PERRY, representing the R. H. Buchanan Co., engineers, Montreal, in connection with the Rider Ericsson Hot Air Pumping Engine Company, recently, at their works, Walden, N.Y., made a test of the new improvements on the hot air pumping engines, which far exceeded any previous tests, and was in all details satisfactory The severest tests were applied.

THE Willson Carbide Works, Merritton, Ont., have been so crowded with orders that they decided to start their works on Sunday; that is, instead of closing at 12 o'clock Saturday night and remaining closed until 12 o'clock Sunday night, they now run until 7 o'clock on Sunday morning, and remain closed until 5 o'clock Sunday afternoon. To these arrangements the Lord's Day Alliance took exception, and caused fourteen of the employees to be summoned before the police magistrate.

THE Hamilton, Ont., papers reported that Engineer Barrow had made a test, for capacity, of the pumps and machinery at the sewage disposal works. The showing made was 3,175,000 gallons in 24 hours, which is 175,000 gallons above the requirements. This work was done with one engine only in operation. Mr. Barrow expects to be able to bring about a great saving in chemicals, not only by a change in the precipitants used, but also through the large settling surface. At the east end works the machinery which runs the pumps is now being used to operate the mixers, and thus a saving in fuel is effected. Mr. Barrow expects, in time, to bring the cost of operation to a much smaller figure than at present. From the number of changes proposed it would appear that plant is at present found to be expensive.

A BRIDGE has recently been completed at Dundas, Ont., that is a decided departure from the usual class of work done by municipal councils. To protect the banks from the cutting action of freshet water, caused by the curving of the current at this point, the abutment walls were made just high enough to provide a margin for highest freshet known, and on the tops of these walls steel rail piers were placed to support the superstructure, and the abutment walls carried up and down stream in such a way as to turn the current, making in all a length of wall of about 200 feet. The walls were topped with a cap having a half-round face, with 4-inch projection and 12 inches depth. All of this work is of concrete construction. John S. Fielding was the designer and contracting engineer; J. F. Armour, the town engineer, in charge.

H. J. BEEMER, president of the Pontiac and Pacific Junction and the Ottawa and Gatineau Railways, stated recently that preparations for beginning active operations on the new bridge that is to be built across the Ottawa from the city of Hull at Nepean Point were well under way. The contract for the substructure has been given to a New York firm, while the superstructure will be built by the Dominion Bridge Company. There will be five piers, with a cantilever span of 550 feet in the clear, with arms of 250 feet each. The total length of the superstructure, according to the plans, is to be about 1,300 feet. The bridge will carry a railway track, two tracks for electric cars and a sixteen feet roadway on each side. The object of the 550 cantilever span is to get the piers out of the great accumulation of sawdust in the Ottawa river. The total cost is estimated at about $750,000.

THE following are some of the orders lately received by the Goldie & McCulloch Co., Limited, Galt, Ont. J. R. McComb, flour mill and oatmeal mill, including engine, etc.; Jas. Pender & Co., St. John, N.B., "Ideal" engine; Michigan Central Railway Co, two locomotive boilers; Montreal Transportation Co., Kingston, "Ideal" engine; Delhi Fruit Co, Delhi, one heater; C. G. Gelinas & Co., Three Rivers, "Wheelock" engine; Jas. Richardson & Co., Kingston, "Wheelock" engine, boiler, condenser, shafting, etc.; Maritime Sulphite Fibre Co., Chatham, N.B., heater; Orangeville Electric Light Co., Orangeville, one boiler; Cronkhite Bros., Wisawasa, engine, boiler, heater, etc.; J. S. Metcalf & Co., Chicago, elevator at Coteau Landing, "Wheelock" engine, condenser, feed pump, two boilers and one "Ideal" engine; G. M. Angier & Co., Boston, for Asylum at Fairville, N.B., two "Ideal" engines, two boilers, heater, feed pump, etc.; N. Wenger & Bros., Ayton, one "Ideal" engine; Ogilvie Milling Co., Winnipeg, Man., two boilers; Dominion Bank, large bankers' safe; Electrical Power and Manufacturing Co., Hamilton, engine, boiler, etc.; Molson's Bank, Montreal, two bankers' safes; D. Marshall & Co., Aylmer, two boilers, heater, etc.; Wm. Hamilton Manufacturing Co., Peterboro, six boilers; M. Beatty & Sons, Welland, one boiler; the T. Eaton Co., Toronto, two "Ideal" engines; S. Lennard & Sons, Dundas, one "Wheelock" engine; Bank of Hochelaga, Sherbrooke, large bankers' safe; Bank of Hamilton, Hamilton, large bankers' safe.

A THEATRE to cost $30,000 will be built in St. Roch's, Que.

THE Granby, Que., rubber factory is being extended. Neil & Kent have the contract at $8,500.

THE Welland Vale Bicycle Co., St. Catharines, Ont., have shipped recently 50 wheels to Austria.

ARTHUR DENISON, Toronto, architect, has passed the Walkerton town hall, and taken it off the contractors' hands.

A CONTRACT for building a bridge over the Holland River near Bradford, Ont., will be let during the coming summer.

RIDGETOWN, Ont., has offered a large bonus and exemption to W. E. Hall, furniture manufacturer, Galt, Ont., to remove to that town.

THE Ontario Rolling Mills, Hamilton, Ont., lost no time in getting their premises into shape after the fire, and will soon have everything in as good condition as formerly.

RHODES, CURRY & Co., Amherst, N.S., recently obtained a contract to build 50 twenty-ton box cars for use on the extension of the Drummond Counties Railway at Montreal.

WORK at the Shawenegan Falls, above Three Rivers, Que., is to start shortly, and the hotel there has been reopened for the accommodation of tourists and people connected with the works.

DARTMOUTH, N.S., has a proposition before it to bonus a pulp mill to have a capacity of 20 tons per day. The promoters have secured options on suitable water power and land in the town.

THE Taylor Air Compressor Company, of Montreal, is installing a 500 h.p. plant at Ainsworth, B.C., and expects to distribute the power to mines within a radius of five miles. A full description of this plant will be found on another page.

THE Almonte, Ont., town council has been approached by the Perth Waterworks Co., asking if the council would be willing to enter into negotiations, even in an informal way, with the ultimate view of granting them a franchise for the supply of water and light.

THE Three Rivers, Que., Iron Works is completing the erection of a large brick machine shop and foundry, in connection with their already extensive works. The firm has large contracts on hand, which will give full work to their establishment for the next few months.

AT a recent meeting of the Essex County, Ont., Council the Road and Bridge Committee sanctioned the construction of the following: New bridge over River Canard, cost $1,732; new bridge over Bell River, cost $1,099; new bridge over Tremblay Creek, on county line between Essex and Kent.

IN April, 1897, the Cooper Machine Company of Toronto was incorporated, with $20,000 capital, one-fourth of which was paid. Last month the creditors had a meeting, and their statement showed assets of $4,800, against liabilities of $5,500. An offer of 40 per cent. was made and accepted.

THE local papers in Almonte, Ont., are discussing a system of water works for that town. The finances of the town are in good condition, and such a scheme might be put through; however, the laying down of the mains would be a most expensive undertaking, as almost every foot of excavation would be rock cutting.

JOHN MCCONNELL, of McConnell's Electric Carriage Works, Guelph, Ont., has invented a carriage wheel which ought to prove a revelation in carriage manufacture. The new wheel is set on roller bearings and has no boxings to break or get loose. It is dustproof, and requires oiling once in a season, there being no friction to require the continuous use of oil.—*Guelph Herald.*

THERE was a meeting of the Iron Founders' Association of Montreal recently, in the reading room of the Laurie Engine Company. Among those present were: W. H. Laurie, H. R. Ives, J. H. Garth, Thos. Monaghan, Wm. Rodden, John Laurie, E. Lamb and G. H. Weaver. During the evening a most interesting paper on "The Chemistry of Iron" was read by Ernst A. Sjostedt.

THE board of management of the public works of St. John, N.B., will receive tenders till April 1st for the supplying of about 3,116 tons of best quality 24 and 12 inch cast-iron water pipe, according to specifications and drawings prepared by Wm. Murdoch, Esq., C.E., engineer and superintendent S. and W. Supply, copies of which specification may be had on application to the director, A. Chapman Smith.

IN our last issue, THE CANADIAN ENGINEER stated that a writ had been issued against the Welland council of 1897 by the Waterous Engine Works Company, claiming damages for the non-fulfilment of a contract to purchase a fire engine. The statement, we find, is incorrect. A local informant states that our item might truthfully refer, however, to the village of Fort Erie, which is having some trouble with the Waterous Company.

THE secretary of the General Hospital, at Kingston, Ont., has been instructed to advertise for tenders for the reconstruction of the Watkins' wing, the cost of which is estimated at $12,000. The plans provide for twenty rooms. The question of putting in an elevator has not yet been decided.

THE Somerville course of lectures for 1898 at the Natural History Society Hall, Montreal, has been announced. The following lectures will interest our readers: Thursday, March 24th—The Modern Steamship, by Prof. A. J. Durley, B.Sc., Assistant Professor of Mechanical Engineering, McGill College. Thursday, March 31st—Precious Metals: Where they come from and how they occur, by Prof. F. D. Adams, M.A.Sc., Ph.D., president of the Natural History Society. Thursday, April 7th—Coal and Iron, by Osmond E. LeRoy, B.A., of McGill College. Thursday, April 14th—Our Railways, by Prof. Cecil B. Smith, M.A.E., Assistant Professor in Civil Engineering, McGill College.

IN the works of the Robb Engineering Co., Amherst, N.S., has a concern of world-wide reputation. At present, in every department, the hum of industry is heard, not only during the day, but night. Recently there was a test of a Robb-Armstrong engine. This one, which is compound, goes to Europe to be placed in an electric installation, and will be completed and ready for shipment at an early date. It is 125-h.p. Besides this one just referred to, three compound engines of the same type, each 200-h.p., being made for a foreign order, two of 225-h.p. each, for the Rathbun Co., Deseronto, Ont., and two more of 150-h.p., each, simple, for St. Thomas, Ont. These engines are of the side-crank type. In another part of the premises a large boiler is being finished, which will go to Parrsboro, N.S. It is known as the Mumford improved patent boiler. It is entirely cased in, with furnace in centre, and the smoke returns round the outer part of the shell. The boiler is arranged so that the water has a positive circulation, and the steam is collected in a large horizontal dome at the top. The whole arrangement is such that a great saving in fuel is claimed to be effected.

THE new steel swing bridge across the Lachine Canal at Seigneurs street, Montreal, for which tenders have been called, is to replace the present old structure, which is too light in construction to allow of an electric car service. It has only a clear roadway of seventeen feet, and a total width of twenty-eight feet. The new structure will have a clear roadway of thirty-seven feet, with two sidewalks of four and a half feet in width, and a clear roadway of twenty-six feet. Its length will be one hundred and thirty-eight feet between ballast walls, and be about eighteen inches higher than the present structure. The Atwater avenue bridge across the Lachine Canal is expected to cost about $75,000. The bridge is to be a swing bridge, with a clear span between abutments, ballast wall of two hundred and forty-three feet. The total width of the bridge will be thirty-eight feet, giving five-foot sidewalks on each side. The bridge can be built during the season of navigation, the abutments being placed far enough from the canal bank, so as not to interfere with the canal walls. The centre pier is founded on concrete placed within a square made of piles, with rods passing through the walling pieces. The rest pier work down the centre of canal, is composed of cribs, with ten-foot openings, and will be about two hundred and ninety feet in length.

RECENTLY a number of the people of Sarnia, Ont,, witnessed at the Doherty Stove Works a test of T. Doherty's latest improvement in iron casting—the transforming of cast iron directly into steel by an air blast, passed through the melted metal as it emerges from the cupola. For some time Mr. Doherty has been at work on a new method for decarbonizing iron in the process of casting and bringing the resultant metal to a higher grade of steel than was obtainable by his original process. The basis of the latter was the introduction of a steam jet to the cupola. The new process is based upon the use of compressed air. A specially designed cupola also forms part of the new process, we are informed by a local contemporary. The metal, as melted, drops in a small stream through the bottom of the receptacle to a receiver below, and as it falls through a powerful blast of air is directed against it, which blows out the impurities, which find escape through an opening in the back of the cupola. The effect of the introduction of air under pressure is marvellous. The carbon, sulphur and silicon in the iron can be eliminated to any extent desired by the foundryman by regulating the pressure, with the result of producing a steel casting suitable for the class of work for which it is required. At the test described the blast was regulated for stove plate casting and did not show the highest results obtainable, but it clearly demonstrated the superior character of the process over that of the original patent. Metal produced under the air blast process shows all the characteristics of steel under the hammer, the drill or the lathe, and there appears to be no doubt that Mr. Doherty has solved the problem of producing steel from ordinary pig iron at a single process, at once simple and cheap.

J. E. Lusby intends starting a feed mill at Amherst, N.S., in a short time, and has ordered a 40-horse power boiler and engine from the Robb Engineering Co.

Senator Poirier, Shediac, N.B., has ordered a 60-horse power engine and boiler from the Robb Engineering Co., Amherst, N.S., for running a flour mill and shingle mill.

An application has been made for a charter under the name of the Nickel Steel Company of Canada, the incorporators being: John McLaren of Brockville, manufacturer; George B. Douglas, of New York, manufacturer; Alexander Fraser, of Ottawa, lumberman; David McLaren, of Ottawa, lumberman; F. F. Vandervoort, of Pittsburg, manufacturer; George A. Cox, of Toronto, capitalist; Nathaniel Dyment, of Barrie, lumberman; Alexander McLaren, of Buckingham, lumberman; Andrew Trew Wood, M.P., of Hamilton, merchant; John Moodie, of Hamilton, capitalist, and John Patterson, of Hamilton, secretary. The company wants power to "explore for, develop, operate and acquire by purchase, lease or otherwise, gold, silver, copper, nickel, lead, iron, coal and other mines and properties, and to dispose of the same by sale, lease or otherwise; to manufacture and treat metals, minerals and ores, and to carry on the business of manufacturing therefrom and in combination with other metals, minerals, ores, substances and minerals and all articles of merchandise that may be manufactured therefrom." It also wants power to construct railways to reach or connect the mines, etc., and to establish steamship lines. John Patterson, Hamilton, the promoter, says there is $20,000,000 of capital behind the enterprise.

Electric Flashes.

The Guelph Light and Power Company recently started up its new Brush arc machine.

The Cardinal, Ont., Electric Light Company, Limited, has been incorporated; capital, $20,000.

The Buckingham Reduction Co. of Buckingham, Que., is installing a 200 K.W. power generator. The order was given to the Royal Electric Co.

The Richmond County Electric Co. has purchased a 60 K.W. "S.K.C." two-phase generator from the Royal Electric Co.

The Toronto Railway Company has just placed an order with the Canadian General Electric Company for 20-G.E. 1,000 motors with K-10 controllers.

S. Lennard & Sons, of Dundas, placed an order some time ago with the Canadian General Electric Company for a 100-light incandescent plant.

The Ossekeag Stamping Company, Hampton, N.B., has purchased a 200-light incandescent plant for lighting the works from the Royal Electric Co.

The Sherbrooke, Que., Street Railway Company has recently placed an order with the Canadian. General Electric Company for additional G.E. 1,000 equipments.

The British Columbia Railways Company has placed an order for a freight car, using "Brill" trucks and G.E. 1,200 motors, with the Canadian General Electric Company.

The Electric Light Co., Edmonton, N.W.T., has purchased a new plant complete, including a 75 K.W. "S.K.C." two-phase generator, with "Stanley" transformers, from the Royal Electric Co.

The Midland Electric Light Co., Midland, Ont., recently placed an increase order with the Canadian General Electric Co. for a 60-kilowatt, single-phase alternator of the company's standard type.

The Metropolitan Street Railway Company, Toronto, has placed an order with the Canadian General Electric Company for G.E. 1,000 equipments to replace the motors burned in the fire recently at the car barn.

W. B. Davey will immediately commence work for the lighting of Grand Forks, B.C. The order for the electrical machinery complete, including a 1,500 light alternator, has been given to the Royal Electric Company.

The Chateauguay and Northern Railway Co., Montreal, has placed an order with the Canadian General Electric Company for a 325-kilowatt steel frame generator. This will give that road a total capacity of 525 kilowatts.

The Hull, Que., Electric Company has ordered thirty-six G.E. 1,000 motors from the Canadian General Electric Company. These will be used as four-motor equipments, making in all fifty-two motors of this type which the Hull electric road will have in operation.

The Canadian General Electric Company is supplying three small direct connected units for the C.P.R. steamships on the Stikine River. These machines will be 4 kilowatts each, direct connected to vertical engine of special type, running at 600 revolutions per minute

The Canadian General Electric Company has been awarded the contract for supplying electrical machinery for lighting and power purposes at Ashcroft, B.C. The three-phase system will be used, and the pumping for the town waterworks will be done by an induction motor.

The Canadian General Electric Company has closed a contract with the Montreal Transportation Company at Kingston, Ont., for a 25-kilowatt generator of the well-known direct connected type. This machine will be used for lighting the new elevators and other buildings of the company at Kingston.

There is a good deal of favorable criticism of the kindly action of the Royal Electric Company in coming to the assistance of the Lachine Rapids Company, the power-house of which was burnt on the 6th ult. The Royal Electric Co. lighted Westmount and Mile End for its competitor.

The council of Orillia, Ont., has instructed Wm. Kennedy, jr., hydraulic engineer, Montreal, to visit the Ragged Rapids and give an estimate of the probable cost of the hydraulic work, with information as to the best methods, etc. The Canadian General Electric Co. and the Royal Electric Co. have been asked to estimate on the proposed municipal lighting and power plant.

The Canadian General Electric Company has been awarded the contract for supplying the entire electrical equipment for the new St. Thomas Street Railway. The order covers two 100 kilowatt generators, and eight two-motor equipments. The order for cars was given to the Ottawa Car Company, and for steam engine to the Robb-Armstrong Engineering Company, Amherst, N.S.

The Auburn Power Co. at Peterboro, Ont., has ordered a direct connected sub-station unit from the Canadian General Electric Company, consisting of a 75 horse-power induction motor. From this outfit current will be supplied at 500 volts to small power users throughout the town of Peterboro, it having been found that the high price of induction motors prevented their general use.

The Electric Reduction Company, of Buckingham, P.Q., have placed an order with the Canadian General Electric Company for a 1,000 horse-power three-phase revolving field generator to be used for electrolytic work. The machine will be similar to those installed at Lachine and West Kootenay, except that the current will be supplied at the low potential of 75 volts.

The Canadian General Electric Company has closed a contract with the E. B. Eddy Co., Hull, Que., for a 500 and 350-light multipolar direct current generator, for lighting its mills at Hull. With these machines will be installed standard marble panels containing instruments of the latest type. The contract also covers the supply of material for the wiring of the place in strict accordance with the latest standard requirements of the fire underwriters.

The Sydney Electric Light and Gas Company, of Sydney, C.B., is making extensive alterations and additions to the plant, and has placed an order with the Royal Electric Co. for one 60 K.W. and one 40 K.W. "S.K.C." two-phase alternator, these machines being connected to deliver 150 volts per phase. This is the fourth order that has been placed with the Royal Electric Co. for low tension generators of this type within the last few months, and is an evidence of the growing popularity of these machines.

The Toronto Railway Company recently placed an order with the Canadian General Electric Co for an 850-kilowatt direct connected, direct current generator, which has since been installed and is now in operation in the power house. This machine is practically identical with one of the same type and size supplied by the Canadian General Electric Company to the Toronto Railway three years ago. The new machine is being installed to take the place of a direct connected unit, of another make, which had to be discarded.

The T. & H. Electric Co., successors to Kay Electrical Manufacturing Co., reports the following recent sales in Hamilton, Ont. Norton Manufacturing Co., 15-h.p motor; Bain & Colville, 20 light dynamo; Max Bernstein, 1-h.p. motor; Leitch & Turnbull, 10-h.p. and three 15-h.p. direct-connected elevator motors and attachments; Bain & Sache, one 1-h.p. motor and 12 light dynamo; Electric Light and Power Co., several motors; G. H. Meakins, Esq., one 1-h.p. motor; Ontario Plating Works, one 400 gal. plater; Domestic Specialty Co., one 5-h.p. motor; D. Moore & Co., Limited, one 150 gal. plater; Tolton & McKay, one 1-h.p. motor; City Brass Foundry, one 5-h.p. motor; Hand & Teale, one 1-h.p. motor; Post Office, one ½-h.p. motor; Geo. D. Membery, one 3-h.p. motor.

A BY-LAW for the establishment of an electric light system for Beeton, Ont., was voted on and carried by a unanimous vote a short time ago.

THE Welland, Ont., Aqueduct and Power Company has been organized, with a capital of $25,000, to supply electricity for light, heat and power.

THE Acadia Coal Company's charter, Stellarton, N.S., has been amended so as to permit the company erecting an electrical plant and all necessary requirements for electric lighting.

THE British American Light and Power Company is seeking incorporation to build electric tramways and operate systems for electric lighting in the Yukon district, Northwest Territories and Northern British Columbia.

CHIEF ENGINEER HOBSON, of the Grand Trunk Railway, and a representative of the General Electric Co., spent a day a short time ago looking over the tunnel, with a view to introducing electricity to supersede steam as a motive power.

THE Royal Electric Co. has presented its friends with a very handsome desk convenience, which consists of a very large and well-bound blotting pad, with a calendar and indexed engagements book in the margin. The whole souvenir is one of the most beautiful and serviceable articles it has been our pleasure to receive in a long time.

BY Ontario letters patent, the Saugeen Electric Light and Power Company of Ontario, Limited, has been incorporated. Charles Edward Kilmer, of Southampton, electrician; Clarence Hurd Burnham, of Port Elgin, electrician; Joseph Barber and James Barber, of Georgetown; Edward Kilmer, merchant, of Walkerton, are the parties. Capital, $20,000.

MARKHAM, Ont., has settled its claim against the Waterloo Mutual Fire Insurance Company, caused by the burning of the waterworks and electric light station on the 16th ult. The loss claimed by the corporation was $1,593, on which $1,550 was allowed by the company's inspector. The council started at once to rebuild. The new boiler and engine room will be made fireproof.

IN a recently published interview, B. S. Jenkins, superintendent of the Canadian Pacific Railway Company's telegraph, said that a heavy copper wire is to be strung from Montreal to the Pacific coast, the work to begin almost immediately. The new cable to be laid between Vancouver and Victoria left England on one of the company's new steamers recently purchased for the Yukon Territory trade.

THE first regular meeting of the Royal Electric Engineering Society was held in Montreal not long ago. The following were elected officers for the present session: Hon. president, Wm. H. Browne, general manager Royal Electric Company; president, Wm. Bucke; vice-president, W. S. Dix; corresponding secretary, R. F. Morkill; recording secretary, W. G. Angus; treasurer, L. A. Howland; librarian and curator, F. Cushing; committee, J. Burnett, L. Mudge, K. B. Thornton. This society has been formed by the members of the engineering staff of the Royal Electric Company, and has as its primary object the advancement of knowledge in engineering subjects.

THE Toronto Electric Motor Co., Toronto, and Thompson Electric Co., Hamilton, have amalgamated, the change in the firm to take effect on the 15th inst., under the name of "Toronto Electric Motor Co., Limited." The Hamilton factory will be moved to Toronto, and will occupy the new buildings which the company is to finish by the first of May. The new shops will be of the most modern type, with traveling cranes, etc. With this change the new company will be in a position to do the heaviest work in power apparatus, also arc and incandescent work of every kind. All communications should be addressed to Toronto Electric Motor Co., Limited, 107 Adelaide St. West, Toronto, Ont.

D. A. STARR, president and manager of the Cornwall, Ont., Electric Railway Co., appeared recently before the council of Peterborough, Ont., and explained a scheme for the construction of an electric road from there to Chemong and Lakefield, and connecting in town with the Jackson and Nicholls park, and south to the locks. Mr. Starr said his company also proposed to place four steamers on the back lakes, one steamer to run to Stony Lake, two on the Lakefield-Chemong round trip, one leaving each place each morning, and the fourth running from Chemong to Bobcaygeon. The electric road, Mr. Starr explained, would handle freight, and give a half hour service between Peterborough and Lakefield and Chemong. The company propose to lease both the Chemong and Lakefield lines from G.T.R., convert them into electric line and take over its freight business. The former road would be diverted so as to enter the park. The cost was roughly estimated at $350,000, and the company asked the town to guarantee the interest for twenty years on $150,000 of bonds at 5 per cent.

THE new 2,000 light dynamo purchased by St. John's, Que., in January, to replace the present machine, has been installed.

WE are indebted to the Packard Electric Co., St. Catharines, Ont., for their neat monthly memorandum books and blotter calendars.

THE city of Three Rivers, Que., and the North Shore Power Company are negotiating for the running of the waterworks by electricity.

CHAS. MACBETH, son of Col. Macbeth, London, Ont., has been appointed engineer-in-charge of the construction of the St. Thomas street railway.

THE town council of Napanee, Ont., has accepted a proposition made by J. R. Scott, agreeing to install an incandescent and arc plant within one year.

AN accident to the generating plant of the Electric Power Co., at Montmorency, left the twenty thousand incandescent lamps in Quebec City in darkness, on Sunday, 27th February.

ENGINEER LEYDEN, of the Cataract Power Company, has submitted to E. G. Barrow, city engineer, Hamilton, Ont., a proposition for running the sewage disposal works by electrical power.

THE Halifax and Bedford Electric Company is seeking incorporation to build an electric railway from Halifax to Bedford, with such extensions as may be approved of by the municipalities. The head office of the company will be in Halifax, and the capital stock is placed at $250,000.

IT is stated that the Montreal Street Railway Co. will leave its present power house to the Royal Electric Co., and that it will be kept in reserve in case of accident, when the new arrangements are put in operation by which the street railway will be run by power from Chambly.

THE British-American Light and Power Company are applying to the Dominion Parliament for power to construct and to operate by electricity and other power, tramways at Dawson City, Fort Selkirk, and points in the Yukon and North British Columbia; and to operate heating and lighting systems.

APPLICATION is being made for incorporation of the North Shore Electric Railway Company, with powers to construct a railway on the north shore of the St. Lawrence, starting from a point near Three Rivers and through the district of Three Rivers and other districts. Also to generate and sell electrical energy.

AT the next session of the Legislature a Winnipeg company will ask for a charter to build an electric railway from that city to St. Andrew's Rapids, and through the municipalities of Springfield, St. Boniface, Kildonan, St. Paul's and St. Andrew's. The company also propose to construct saw mills, boats, telegraph and telephone lines.

SHAREHOLDERS of the Hamilton Radial Electric Railway met Feb. 22nd to consider matters the outcome of the relinquishment of the Leather interest in the road. The business was not in shape for immediate consideration, however, and the meeting was adjourned for two weeks. With the retirement of Thos. E. Leather from the company it is probable that the original idea of continuing the railway through Burlington and on to Bronte will be dropped, at least for this year.

JNO. PATTERSON, engineer of the Cataract Power Co., Hamilton, is also interested in promoting the new company which is being formed to manufacture steel and nickel, and electric power will be used. The water will be taken from the Chippewa Creek and the power canal will be enlarged to double its capacity. The power houses will be at Reynoldsville, Ont. Mr. Patterson states that power will be generated by his company by May 1, although it will be months before the works are completed. Poles are now being distributed along the G.T.R., and power will be conveyed to Hamilton, Ont., along that route.

AT the annual meeting of the Toronto Electric Light Company, the financial statement presented showed a surplus of $7,000 over dividends paid. A steady growth is shown in the business all through the past year, especially in private incandescent lighting and power. The old board of directors were re-elected, as follows: H. M. Pellatt, president; W. D. Matthews, vice-president; S. F. McKinnon, Hugh Blain, W. T. Murray, Hon. Geo. A. Cox, Robert Jaffray, W. R. Brock, A. E. Ames, Samuel Trees, Thomas Walmsley, H. P. Dwight, Frederic Nicholls, Hugh Ryan. J. J. Wright, general manager; W. A. Martin, secretary.

THE annual meeting of the Bell Telephone Company was held in Montreal, February 23rd. The net revenue for 1897 was $297,751.57, and after dividends have been deducted the company will carry forward $82,364.17 to its 1898 account. There were present at the meeting: C. F. Sise, president; R. Mackay, F. X. St. Charles, G. A. Greene, P. R. Gault, Hugh Paton, C. R. Hosimer, R. Archer, R. W. Shepherd, Chas. Cassils, T. D. Hood, F. G. Payne, R. P. McLea, C.

A. Briggs, C. F. Paul, James Wilson, Herbert Wallace, George Sumner, H. A. Budden, M. S. Foley, E. Rawlings, John Crawford, J. A. Grenier, George H. Holt, D. Ross Ross, Charles Garth, F. B. McNamee, James Shearer, James Williamson. The annual report was submitted as follows: "Nine hundred and eighty-three subscribers have been added during the year, the total number of sets of instruments now earning rental being 30,445. The company now owns and operates 349 exchanges and 261 agencies. Thirty-five miles of pole and 703 miles of wire have been added to the long distance system in 1897; of these five pole miles and 200 wire miles are in the Ontario department, and 30 pole miles and 494 wire miles are in the Eastern department The long distance lines now owned and operated by the company comprise 16,567 miles of wire on 6,095 miles of poles. Under the authority of the shareholders $66 500 bonds have been sold during the year, the premium thereon being 10 per cent. Continuing the policy adopted in past years, your directors have charged to contingent fund $150,000, that amount having been expended during the year on construction rendered necessary by the introduction of trolley and other strong wires, but which has not increased the earning power of the plant. The following directors were elected: C. F. Sise, Robt. Mackay, John E. Hudson, Robert Archer, Wm. R. Driver, Hugh Paton, Charles Cassils, Thos. Sherwin.

Railway and Marine News.

THE story is revived that the C.P.R. will erect a million bushel elevator at St. John, N.B.

IT is proposed to run one of the Conneaut car ferries to Port Burwell, Ont. this season, instead of both to Port Dover.

GEORGE F. BAIRD, Yarmouth, N.S., has purchased the steamer "City of Monticello," for a price in the vicinity of $20,000

A DEPUTATION from Lancaster, Ont, has requested the Dominion Government to make an appropriation of $10,000 for a wharf there.

THE Sault Ste. Marie *Star* says the steamer "Cambria" will be thoroughly rebuilt and again take her place on the Windsor-Soo route.

THE Alberta Railway Company have sold to Mackenzie & Mann, for use on the short line to Lake Teslin, a quantity of steel rails and four locomotives.

A SYNDICATE has been formed to operate two steamers on the Kingston and Wolfe Island ferry, and Kingston and Gananeque route, the coming season.

THE contract for building the Cobourg, Northumberland and Pacific Railway, running north from Cobourg, Ont., to the C.P.R., has been signed by C. H. Bowen.

IT is stated on good authority that the present intention of the company which controls the M. & N.W. Railway is to extend the line to Prince Albert this year.

THE Grand Trunk Railway authorities are putting new colonist cars on their Winnipeg route that for comfort and appearance excel anything of the sort yet seen in this country.

REPRESENTATIVES of D. C. Corbin have succeeded in obtaining the endorsation of the council of the Rossland Board of Trade for a railway charter from Cascade City to Grand Forks.

THE Grand Trunk Railway system has received for service in its western traffic ten locomotives of the heaviest and most powerful build, from the Baldwin Locomotive Company, at Philadelphia.

THE contract for building the Midland Railway line from Windsor to Truro, N.S., 60 miles, has been let to Fitzpatrick Bros., New Glasgow. The road will be graded and ironed by next fall, it is said.

THE C.P.R. shops are busy turning out new passenger coaches and locomotives to meet the demand for new rolling stock created by the boom in business and the extension of its service in the West.

THE second compound locomotive ordered by the Canadian Government Railway System from the Baldwin Locomotive Works, Philadelphia, has been shipped to Montreal, where it will be put together.

THE Canadian Pacific Railway has sent a representative to Newfoundland to engage 1,500 laborers to proceed to British Columbia to work on the Crow's Nest Pass Ry. The wages offered are $1.50 a day.

THE Government has decided to send immediately the chief engineer of the Department of Public Works, Louis Coste, and the chief engineer of the Department of Marine, Lt.-Col. Anderson, to the Stikine River and over the Canadian route to Dawson city, for the purpose of seeing what improvements are necessary to overcome obstructions to navigation. It is also the intention to erect a wharf at Dawson after inspection.

THE new pier at Margaretville, N S, is completed, and the cost, $10,854, slightly more than the tender of the contractors, Simmons & Burpee, Gibson, N.B. The work has been done to the entire satisfaction of the Dominion Government engineer, C. E. W. Dodwell. As Margaretville is the nearest approach to a natural harbor on the Nova Scotia shore, between Minas Channel and Digby Gut, the necessity of a safe breakwater has been admitted.

THE Newfoundland cabinet has concluded an arrangement with R. G. Reid, the contractor who built the Transinsular Railway, to operate the entire railway system of this colony, six hundred miles, for fifty years, in return for a land subsidy of 2,500 acres per mile. Mr. Reid will pay over to the Government one million dollars guarantee. This money, with the interest accumulations for fifty years, will belong to the colony at the expiration of that period, the railway then reverting to the representatives of Mr. Reid.

DAVIS Dry Dock Company is very busy this spring filling orders for launches, etc. There are being built a passenger and freight steamboat for Homer & Co., of Gravenhurst, Ont.; 25-foot steam launch for Muskoka Lake; three boats for the Adirondacks, for New York owners; one 17-foot ¾ h.p. gasoline motor; one 20-foot long gasoline motor, one 36-foot long steam engine, beside one 34 feet long and another 50 feet long on the stocks. They are getting out plans for a 20-foot boat with a small steam motor to fit back in the stern, a very pretty little launch, with plenty of room and at a very small cost.

THE steamer "Tecumseth," owned by McArthur Bros, Toronto, will undergo considerable alterations to her machinery this season at the hands of the Bertram Engine Works. The two present fire-box boilers, which are allowed 65 lbs. per square inch, will be removed, and replaced by one "Scotch" boiler 11 feet diameter, with a working pressure of 130 lbs. per square inch. This boiler will be fitted with a complete installation of the "Howden Hot Air Draft," in which the air is considerably heated by the escaping funnel gases before being forced into the ashpits. The present cylinders, which are 26 and 48 inches diameter, will be replaced by new ones of 19 and 40 inches diameter, the rest of the engine remaining practically as at present. The results anticipated are an increase of power, economy of fuel, both as regards quality and quantity, less weight of boiler, and more stowage room in the ship. As this is the first installation of the "Howden" draft on a Canadian lake vessel, it will be watched with interest. The work is under the supervision of A. P. Rankin, consulting engineer, of Toronto.

CHICAGO forwarders have sent out the following circular:—"It is our intention to put on three boats from Chicago to Parry Sound, the capacity of which will be in the neighborhood of 3,000 tons each, which will call at Milwaukee; also, two boats from Duluth, with about the same capacity. At Chicago we have leased a dock between the Ogdensburg Transit Company and the Lehigh Valley Transportation Company's dock, on which there is being erected a warehouse about 125 feet long, with an average width of 110 feet. At Parry Sound we have an elevator now ready for the handling of grain, with a capacity of about 1,250,000 bushels, and will have a warehouse 600 feet long by 80 feet wide, also a flour house 600 feet long by 80 feet wide, together with 2,500 feet dockage accommodation, on a 22-foot water line. We are also building at Coteau Landing, on the St. Lawrence river, at the mouth of the Soulanges Canal, a transit elevator, of 500,000 bushels' capacity, which will handle 240 carloads a day, also a warehouse and docks of sufficient dimensions for the handling of flour and package freight, our idea being to float our grain and package freight to Montreal and deliver alongside of the ocean vessels in Montreal harbor."

Mining Matters.

OIL has been struck at Croton, Bothwell county, Ont. The field is said to extend over an area of several miles. Some splendid wells have been struck on the town line of Zone and Camden.

THE Hall Mines Co. has closed a contract with the Dominion Wire Rope Company, Limited, Montreal, for 10 miles of wire rope for its cable way from the mines to the smelter. Its weight will be about 40 tons, and it will be made in six sections of over 1½ miles in length, for convenience in handling.

WHAT is known as the Dickenson mine in Michipicoten, Ont., has been sold to an English syndicate. George Fee, and J. J. Mackey, of North Bay, and J. L Caverhill, Montreal, were the vendors. E. A. Bremner, an English mining expert, acted for the syndicate. This claim was the first discovered in the Wawa, Ont., district.

CONSIDERABLE excitement has been caused in the county of Megantic, Quebec, by the discovery of gold on the banks of the Bullard Brook. The discovery was made late in the autumn, and several pits have been sunk, and in every case gold in small quantities has been found in the black sand that seems to be scattered over the whole of the flats.

THE annual meeting of the shareholders of the Intercolonial Coal Mining Company, Limited, took place recently, in Montreal. The sales of coal and coke, for the year ending Dec. 31st, 1897, amounted to 186,654 tons. The following were elected directors of the company for the ensuing year, viz.: James P. Cleghorn, president; H. S. MacDougall, W. M. Ramsay, Thomas Wilson, E. Goff Penny, M.P.; A. W. Hooper, R. MacD. Peterson, Charles Fergie, vice-president, and Wm. J. Nelson.

IN a report to Arch. Blue, director of the Bureau of Mines, Ontario, Prof. De Kalb, the new professor of mining engineering at Kingston School of Mining, says that the corundum in the counties of Hastings and Renfrew is very rich. Tests have been made showing that concentrates may be made giving ninety-two to ninety-four per cent. of corundum, and as the commercial standard of purity only requires eighty per cent. of corundum, it appears that this limit can be easily passed. Another thing that he says is that there is little difficulty in separating the corundum from the magnetite.

THE Geological Survey of Canada has just issued a summary of the mineral production of Canada for 1897, which, without being final—some of the figures not being obtainable just at present—is based on a general knowledge of the progress made in the various industries, and is sufficiently accurate for all practical purposes. The report shows that the value of the gold produced amounted to $6,190,000; of copper, 13,300,802 pounds were produced, value, $1,501,660; of lead, 39,018,219 pounds, value, $1,396,853; of nickel, 3,997,647 pounds, value, $1,399,176; of silver, 5,558,446 ounces, value, $3,322,905; of iron ore, 71,451 tons of two thousand pounds, value, $178,716; of mercury, 688 pounds, value, $324, and of platinum a value of $6,600. The report will be taken up fully in a later issue of THE CANADIAN ENGINEER, when the production in the United States will also be given, so that the relative increase in the two countries may be considered.

Personal.

WE regret to state that Wm. Hamilton, manager of the St. Lawrence Foundry, Toronto, was stricken with paralysis recently.

WM. MCLEAN, of the McClary Manufacturing Co., Limited, London, has gone to take charge of the company's office in Winnipeg.

P. S. ARCHIBALD, ex-chief engineer of the I.C.R., is engaged by Sir Charles Tupper as chief engineer of the Klondyke Mining Company.

T. H. WHITE, St. Thomas, Ont, has been appointed chief engineer for the new line of railway to be built from the Stikine River to Teslin Lake.

HENRY BUDDEN, vice-president and managing director of the Intercolonial Coal Company, of Pictou, N.S., has resigned that office on account of ill health.

JAMES WARNOCK, one of the most prominent citizens of Western Ontario and a leading manufacturer in Galt, Ont., proprietor of the Galt Edge Tool and Axle Factory, died at his home the 5th February.

W. A. CARLYLE, British Columbia provincial mineralogist, has handed in his resignation, to take effect April 1, when he will leave for Rossland to accept the mining superintendency of the British America Corporation.

RICHARD G. MCCONNELL, geologist of the Dominion Geological Survey, has been appointed mineralogist of the British Columbia Government at a salary of $4,000. Mr. McConnell has been with the Geological Survey since 1879, when he graduated from the science school of McGill University.

IN attempting to remove a piece of wood that had stuck fast in a bed planer, Norton Olds, employed in the Mann Manufacturing Co.'s works, Brockville, Ont., accidentally placed his right hand in the knives, which gradually drew the arm in, cutting it off by inches to within a short distance of the shoulder.

MRS. ANN OWEN GREENING, widow of the late Benjamin Greening, founder of the B. Greening wire works, Hamilton, Ont., died at the residence of her daughter, Mrs. R. H. Merriman, Hamilton, recently, aged 88 years. Her husband died 21 years ago. Five sons and two daughters survive her.

CHAS. B. BROWN, of the Ontario Rolling Mills, Hamilton, Ont., has gone to Tacoma, Washington, to accept the position of superintendent of the Western Iron and Steel Company. Before leaving he was presented with an address and a purse of gold by his fellow employees of the rolling mills.

CHAS. DAWSON, who for the past five years has been Works Superintendent for the Central Bridge and Engineering Co., Peterboro, Ont., and was formerly with the Canadian General Electric Co., as master mechanic for the Engineering Department, has resigned his position with the former and has accepted the position of Assistant Superintendent with special charge of all Machine Tool Work for the Dominion Bridge Co., Montreal.

WILLIAM HOLTBY, mechanical engineer of the Canada Atlantic Railway, Ottawa, was accidentally killed at Coteau Junction, Que., Feb. 23rd. He was superintending the replacing of a snow-plough on the track, when he slipped and fell under the train. Mr. Holtby had been a resident of Coteau Landing during the construction of the Canada Atlantic Railway transfer, of which he was the foreman. At the inquest, the jury brought in a verdict that deceased was the victim of an accident due to his own imprudence.

ALEX. DUFRESNE, one of the engineers on the Soulanges Canal, had a narrow escape from drowning Feb. 25th, while sounding for the depth of the water at the head of the canal. Mr. Dufresne, together with A. G. Grant, another engineer, was engaged with his instruments, when the ice suddenly gave way, carrying him with it. Mr. Grant, at the risk of his life, seized Mr. Dufresne and succeeded in pulling him out of the water. The place was a dangerous one, being 25 feet deep and at the head of the Coteau rapids.

LITERARY NOTES.

We have received the "Transit," a pamphlet of 170 pages, published by the engineering society of the State University of Iowa, U.S. It contains some valuable and interesting papers on engineering topics, chiefly by graduates of the University.

We have before us the Proceedings of the Seventh Annual Convention of the Association of Railway Superintendents of Bridges and Buildings. It contains in 275 pages a number of valuable papers profusely illustrated.

The "Mining Resources of Canada" is a pamphlet of about a dozen pages of printed matter and as many more of handsome photo-engravings, issued by the Department of the Interior, Ottawa. A great many statistics are given of the mineral productions of Canada in the past and information about the mineral regions. A large map of the Dominion is also included.

FIRES OF THE MONTH.

Feb. 2nd.—McIntyre block of stores and offices, Winnipeg, Man. Loss about $500,000; to be rebuilt.——Feb. 13th.—Ontario Rolling Mills, Hamilton, Ont., the main building destroyed; the loss was $16,472. The machinery, etc., was insured for $28,000, and the building, owned by the Grand Trunk, for $6,000.——Feb. 16th.—The power house and plant of the Markham, Ont., electric light and waterworks; loss about $3 500.——Feb. 16th.—George Middleditch's foundry and machine shop, Bothwell, Ont. Loss about $7,000.——Feb. 17th.—Waterloo, Ont., Manufacturing Co.'s foundry; damages, $400.——Feb. 19th.—Bismarck cheese factory, near Wellandport, Ont., burnt down; loss about $2,500.——Feb. 19th.—Barrel factory, Lequille, N.S., property of the Union Bank of Halifax; loss about $15,000.——Feb. 20th.—Flour mills, Burlington, Ont., run by W. H. Finnemore, owned by Estate P. Redpath, Montreal; loss about $10,000.——March 4th.—The Goold, Shapley & Muir windmill and bee supply factory, Brantford, Ont.; loss about $20,000.

—A hot air radiator, of special value to all users of wood burning stoves or furnaces, has been invented by R. W. Biggar, Sorauren ave., Toronto. It is a drum to be applied to a stovepipe in the ordinary manner, but, unlike any other heating drum we have seen, it sucks up the cold air from the floor of the room and throws it out at the top of the drum, thus keeping all the air in the room in circulation, and abolishing finally cold floors.

—The Hamilton Acetylene Gas Machine Company's generating apparatus, of which an advertisement appears on another page, possesses many features which make it of great value. The patent water spray, by which the water is supplied to the carbide in the generator, is a special feature of great interest. A further description of this machine will be given in the next issue of THE CANADIAN ENGINEER.

SOME EXPERIMENTS ON THE CONDENSATION OF STEAM.*

By H. L. Callendar, M.A., F.R.S., Professor of Physics, and J. T. Nicolson, B.Sc., Professor of Mechanical Engineering of McGill University, Montreal.

Part I.

As the result of some experiments by electrical methods on the measurement of the temperature changes of the walls and steam in the cylinder of a working steam-engine, which were made at the McDonald Engineering Building of McGill University in the summer of 1895, the authors arrived at the conclusion that the well-known phenomena of cylinder condensation could be explained, and the amount of condensation in many cases predicted from a knowledge of the indicator card, on the hypothesis that the rate of condensation of steam, though very great, was not infinite but finite and measurable. An account of these experiments was communicated to the Institution of Civil Engineers in September, 1896, and will, it is hoped, be published in the course of the ensuing session. In the meantime, the authors have endeavored to measure the rate of condensation of steam under different conditions by a new and entirely different method, with a view to verify the results of their previous work, and also to estimate the influence, if any, of the film of water adhering to the walls of the cylinder.

In considering the condensation of steam on a metal surface it is usually assumed that the surface exposed to the steam is raised up to the saturation temperature corresponding to the pressure of the steam, and that the amount of condensation is limited by the resistance of the water films to the passage of heat from the steam to the metal and from the metal to the water. If the steam contains air, there may also be a considerable resistance due to the accumulation of a film of air on the surface, but it is comparatively easy to exclude this possibility in experimental work.

In the steam-engine experiments, above referred to, it was practically certain that the water film due to the cyclical condensation never exceeded one-thousandth of an inch in thickness, and that the resistance offered by it was unimportant. At the same time, it appeared clear that the temperature of the surface of the metal at its highest was considerably below the saturation temperature of the steam: a condition which could only be explained by supposing the rate of condensation of steam on a surface to be limited by some physical property of steam itself, apart from the resistance of the condensed film of water. Interpreted in this manner, the experiments led at once to the conclusion that the rate of condensation at any moment was simply proportional to the difference of temperature between the saturated steam and the surface on which it was condensing.

The limit thus found was shown to be capable of explaining many of the phenomena of cylinder condensation in a rational manner; but the method by which it was established was of an indirect and somewhat intricate character, and appeared to require some simple and more direct confirmation.

If the rate of condensation of steam were really infinite, it should be possible by a suitable modification of the surface-condenser method (i.e. by getting rid of the water films on the outside of the tubes) to obtain values of the condensation considerably in excess of those given by the formula deduced from the temperature cycle observations.

To accomplish this, it is necessary to eliminate as completely as possible the resistance to the passage of heat through the water films between the steam and the metal, and between the metal and the circulating water, and at the same time to measure as accurately as possible the temperature of the metal.

These considerations led to the form of apparatus which was employed. The resistance to the passage of heat from the metal to the condensing water in this apparatus is practically eliminated by employing a thick cylinder, 5 in. diameter and 2 ft. long, with a screw thread cut on its outer surface. Water from the high-pressure mains is forced to circulate round this surface with a very high velocity in the narrow space between the cylinder and the surrounding tube. In this manner it is possible to obtain a very uniform temperature for the external surface differing but little from that of the circulating water.

If the cylinder is made sufficiently thick, its temperature may be approximately determined at any depth by inserting mercury thermometers. It was intended at first to use thermo-couples for this purpose, but the apparatus in this form would have been unsuitable for students' use in the ordinary course of laboratory work, which was one of the primary objects in view in the construction. It would also have been desirable to make the cylinder of nearly pure copper, which would have reduced the resistance of the metal to the lowest point. The authors were compelled, however, to content themselves for the time with cylinders of cast iron and of mild steel.

The internal surface of the cylinder, upon which the steam was condensed, was a hole one inch in diameter, drilled in the solid metal. In order, as far as possible, to minimize the resistance of the surface film of condensed water, a revolving brush was constructed of very thin strips of steel to wipe the surface five or six times a second. This wiper was found to wear in a very short time to so perfect a fit and the water film must have been so energetically stirred that its resistance to the passage of heat must have been far less than that of the best conducting metal, when there was perhaps some small film present.

Under these conditions, if the rate of condensation of steam were infinite, it should have been possible to obtain a rate of condensation many times greater than the limit deduced from the cylinder-condensation experiments above mentioned.

On making the experiment, however, it was found that the wiper made very little difference to the amount of condensation. With the wiper revolving at the rate of 160 per minute, the condensation was increased by about 5 per cent. on the average of several experiments. It may be concluded from this that the drops of condensed water with which the surface is partially covered are in such rapid motion that they do not appreciably obstruct the passage of heat from the steam to the metal. In fact, Prof. Callendar actually found that the drops increased the condensation. A film of the same average thickness, if it were absolutely quiescent, and if its conductivity, as generally estimated, were only one-hundredth of that of cast-iron, would no doubt prove a serious obstacle; but, as a matter of fact, the viscosity of water at these temperatures is so small, and the motion so rapid, that the drops cannot be treated as a quiescent film.

The temperature at various distances from the inner surface of the cylinder was determined by means of mercury thermometers inserted to a depth of 8 in. or 9 in. in holes drilled parallel to the axis. From the temperatures so observed the conductivity of the metal and the temperatures of its inner and outer surfaces could be approximately inferred. It was found, however, that the presence of the holes interfered materially with the flow of heat through the metal, and that the readings of the thermometer under these conditions were not altogether trustworthy.

From a number of observations on the cast-iron cylinder a conductivity of 5.5 thermal units Fahr. per square ft. per minute per deg. Fahr. per inch was deduced, a result which agrees very closely with the authors' previous determination by a different method. For the steel cylinder a conductivity of 5.8 was similarly deduced. These results apply to a mean temperature of about 140 deg. Fahr., and are much lower than the values generally assumed for iron.

In order to verify the previous results as to the rate of condensation of steam derived from the steam-engine experiments, the temperature of the inner surface of the metal was calculated on the assumption of a rate of condensation equivalent to 0.74 thermal unit Fahr. per second per square foot per deg. Fahr. difference of temperature. The values so found agreed with the observed temperatures within the limits of error of the observations. Owing to the inferior conductivity of the iron the test was not absolutely conclusive, as the difference of temperature between the steam and the surface rarely amounted to as much as 30 deg. With a cylinder of pure copper, and thermo-couples for determining the temperature at a given depth, it should be possible to obtain a more certain confirmation by this method.

In performing the experiments a number of variations in points of detail were introduced from time to time. The flow of the circulating water was varied in velocity, and directed in different ways. In order to secure uniformity in the distribution of temperature measured in different directions from the centre, the spiral circulation was found to be essential. In the second apparatus the screw thread was at first replaced by a baffle-plate, which was intended to direct the water into a spiral course, but the results found were unsatisfactory.

* A paper read at the annual meeting of the Canadian Society of Civil Engineers.

In some cases steam was admitted from the top of the apparatus, and in other cases from the bottom. With the steam supply at the bottom, it was found that condensed water refused to drain down the vertical 1-in. tube in opposition to the current of steam, although the maximum velocity of the steam could not have exceeded 10 ft. per second.

The following set of observations, each of which represents the mean of several taken on similar conditions, will sufficiently indicate the general nature of the results:

The temperatures of the metal at distances of 1 in., 1.5 in., and 2 in. from the axis of the bar were observed by means of mercury thermometers, which were very carefully centred by small iron washers in holes filled with mercury. The hole fitting the bulb of the thermometer was 3-16 in. in diameter. The other holes were 5-16 in.

It will be observed that in this particular set of experiments the temperatures at 1 in. in the metal, when calculated to agree with the assumed rate of condensation, are all too low as compared with those observed, whereas the temperatures similarly calculated at 1.5 in. are all too high. This might at first sight appear to indicate a very rapid diminution of the conductivity with rise of temperature; but after making various tests the effect was traced partly to the disturbance of the heat flow caused by the presence of the holes, and partly to differences of density of the bar in directions at right angles. The latter differences were not observable in the case of the cast iron.

The observations taken at different pressures do not indicate any marked difference in the rate of condensation per degree second. These results, so far as they go, are in agreement with the authors' previous work, but they hope to be able to obtain more conclusive evidence.

Condensation Results Summary. Mild Steel Bar. Wiper Removed.

Condensation. Thermal Units per Square Foot Second.	Steam Temperature Observations.	Surface Temperature Calculations.	Difference, Steam and Surface.	Temperature in Metal at Distances.						Conductivity, K.
				1 In.		1.5 In.		2 In.		
				Calculations.	Observations.	Calculations.	Observations.	Observations.		
	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.		
20.0	330	303	27	208	214	154	152	113		5.84
17.8	300	277	23	193	198	143	142	109		5.66
15.7/8	274	253	21	179	184	136	134	103		5 81

1. With a short length of condenser and a very free escape of steam, the condensation observed was equivalent to 22.2 thermal units Fahr. per square foot per second, for a difference of temperature of 28.5 deg. Fahr. between the steam and the metal surface. This is equivalent to a rate of condensation of

(*Continued on page* xv.)

AN ELECTRICAL METHOD OF MEASURING THE TEMPERATURE OF A METAL SURFACE ON WHICH STEAM IS CONDENSING.

By H. L. Callendar, M.A., F.R.S., Professor of Physics, McGill University, Montreal.

Part II.

The object of the following experiments, which were made at the McDonald Physics Building with a different apparatus, was the measurement of the temperature of the metal surface itself by a more direct and accurate method. It was also desired to verify as exactly as possible whether the rate of condensation of steam at atmospheric pressure was the same as at the higher temperatures and pressures at which most of the preceding experiments were made.

The condenser used for these experiments was a very thin platinum tube, ¼ in. in diameter and 16 in. long. The thickness of the tube was only six-thousandths of an inch, and the greatest difference of temperature between its inner and outer surfaces at the maximum rate of condensation observed in the experiments could not have been greater than ¼ deg. cent.

The mean temperature of the metal itself was determined in each case by measuring the electrical resistance of that portion of the tube on which the steam was condensing. The author has had considerable experience in the employment of this method, which, moreover, is very easily applied if suitable apparatus is available.

The platinum tube was enclosed in an outer tube of brass or glass, and steam was admitted to the space between the two tubes. A steady current of condensing water was maintained through the platinum tube. The amount of condensation could be inferred by measuring the flow of water, and observing the difference of temperature between the inflow and the outflow. In many cases the condensed water was also measured. Applying a small correction for radiation, the two methods always agreed within one-half of 1 per cent. The pressure of the steam in the outer tube, which was never far from the atmospheric, was observed by means of a mercury column.

The conditions of the experiment as to flow of water and steam, size and length of the external tube, etc., could be varied within certain limits. The following is a summary of the more interesting results obtained:

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The Canadian Engineer

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The Canadian Engineer.

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WITH this issue Volume V. of the CANADIAN ENGINEER is completed. On application at this office an index of the year will be sent to any subscriber who wishes to bind the volume.

For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. V.

ROADBED CONSTRUCTION.

ARTICLE 28.—LAYING OUT AND MEASURING WORK.

Cross-sections should be taken at such intervals that the prismoid between two adjacent ones will have planes as boundaries on a top surface with longitudinal convolutions only, extending in straight lines from one section to the other; to do this quickly and without unnecessary sections is a matter of experience and visual judgment, requiring the personal attention of the engineer. The slope stakes should be marked on one side with the cut or fill and on the other with the distance from the centre line; some engineers also write the station (chainage) on the slope stakes. These stakes are put in at every 100 feet in light work and on tangents, but on curves and heavy work they should be put in every 25 or 50 feet, depending on circumstances, and on all side-hill work liable to slip the sections should be carried up the hillside 200 or 300 feet to points beyond any danger of movement, and should be taken before excavation has been commenced.

*This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

There are two methods of keeping notes in use in Canada; in the first, each rod reading is entered in a separate line and the corresponding cut or fill reduced from the grade elevation; in the second method the difference between height of instrument and grade is called "grade rod," and the rod readings are subtracted mentally from it, and the corresponding cuts or fills are recorded, consecutively, on one line of the book in the form of fractions, with the distances from centre line as denominators. It is evident that the first method is more laborious and fills much more space in a note book, and is not so convenient for plotting, but, on the other hand, the reductions can be checked afterwards, and are legal documentary evidence, whereas the second method is entirely one of convenience and leaves great chances for error by careless mental subtraction, which cannot be duplicated, and the note books are, therefore, not very strong evidence in a law court.

Plate XXI

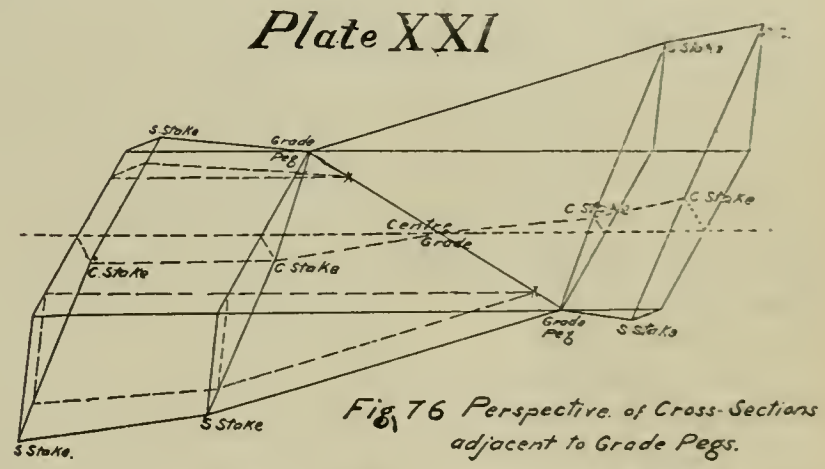

Fig. 76 Perspective of Cross-Sections adjacent to Grade Pegs.

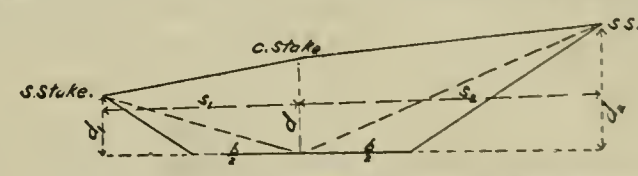

Fig. 77 Ordinary Three-level Section.

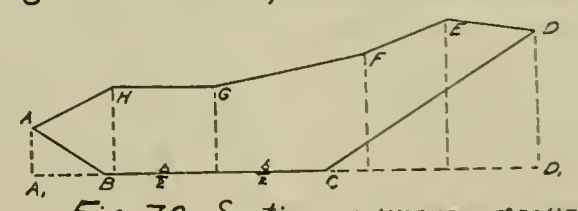

Fig. 78 Section on uneven ground.

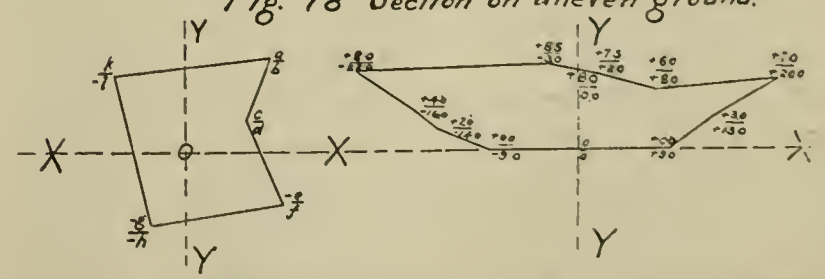

Fig. 79 Eckel's Formula with application to Sections.

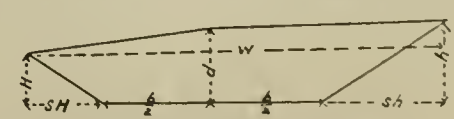

Fig. 80 Prismoidal Formula Diagram.

The following are notes of surface levels of Figure 80 taken by both methods:

(I) ENGLISH METHOD.

Station.	B. S.	H. of I.	F. S.	Int. S.	Ground.	Grade	Cut.	Fill.	Remarks.
102....	..	311.20	..	10.2	301.0	293.0	8.0	..	..
2 R..	..	..	..	10.7	300.5	..	7.5	..	..
8 R..	..	..	..	12.2	299.0	..	6.0	..	..
20 R..	..	..	..	11.2	300.0	..	7.0	..	S. S.
3 L .	..	..	..	9.7	301.5	..	8.5	..	..
22 L..	..	..	..	10.2	301.0	..	8.0	..	S. S.

(II) United States Method.

Station.	B. S.	H. of I.	F. S.	Grade.	Grade rod.	Left.	Centre.	Right.
102...	...	311.20	...	293.0	18.2	(s.s.) $\frac{+8.0}{22.0}$ $\frac{+8.5}{3.0}$	$\frac{+8.0}{0.0}$	$+7.5$ $+\frac{6.0}{8.0}$ $+\frac{7.0}{20.0}$ (s.s.)

The greater simplicity and convenience of the second method commend it to general use in spite of its drawbacks.

On some roads it is customary to take sections after the work is done, and pay for the actual quantities excavated; in others, the slope lines are adhered to and every endeavor is toward the full section taken out. It is probable, however, that the former method is more satisfactory to all concerned, although giving a little extra work to the engineering staff.

Structures need to be staked out twice, once for the foundation pit and again for the laying out of masonry, and of course, on all important structures, measurements and levels are given very frequently as the work progresses, both as an aid and a check to the contractors. A separate note book called a "structure book" should be used, and in it recorded, from day to day, notes of actual sizes, heights and measurements of all structures, and a duplicate office copy also kept up to date for fear of losing the field book. This structure book should include notes on all timber, stone and iron structural work, and will be a valuable aid in case of disputes involving quantities, it will also enable a large scaled profile being made for the maintenance department showing the exact chainage and elevation of each foundation and portion of structure. The necessity for absolute accuracy in laying out, measuring and calculating the quantities in all structures and grading cannot be too firmly impressed on the young engineer; all office calculations should be done in duplicate and preferably by different persons, as one cannot be very sure of a check on one's own work.

Cross Section Areas may be calculated in at least three or four ways, (1) where only a three-level section is taken, as in Fig. 77, the area of the section is evidently made up of triangles and is:

$$\text{Area} = \left(d \times \frac{S_1 + S_2}{2}\right) + \left(\frac{b}{2} + \frac{d_1 + d_2}{2}\right) \quad \ldots\ldots\ldots (1)$$

(2) On rougher ground where more than three surface readings are necessary this method fails and must be replaced by more tedious ones, quite ordinarily Fig. 78 illustrates the one adopted, and consists in taking out the sum of all the trapezoidal areas, $A.A._1D._1D.E.F.G.H.A.$ and deducting the area of the two triangles $A.A._1B.$ and $D.D._1C.$

(3) By careful plotting, irregular areas can be taken out quite accurately with a polar planimeter.

(4) By Eckel's formula, which can be used without plotting the sections, and is equally adapted to the easiest or most difficult rectilinear areas. This formula, which is mathematically correct, is: "If the corners of any rectilinear polygon be referenced by rectangular co ordinates to any origin, then if the ordinate of every corner be multiplied by the abscissa of the next corner. and so on around the polygon, and these products added together; and if the ordinate of every corner be again taken and multiplied by the abscissa of the next corner, passing around the polygon in the *reverse* direction, and these products added together, then the area of the polygon is equal to one-half of the difference of these two sums." As an example, in Fig. 79 the area of the polygon is

$$\tfrac{1}{2}\{[(a \times d) + (c \times f) + (-ex - h) + -g \times -l) + (k \times b)] - [(a \times -l) + (k \times -h) + (-g \times f) + (-c \times d) + (c \times b)]\} \quad \ldots\ldots\ldots (2)$$

or,

$$\tfrac{1}{2}\{(a \times d) + (c \times f) + (c \times h) + (g \times l) + (k \times b) + (a \times l) + (k \times h) + (g \times f + (c \times a) - (c \times b)\} \quad \ldots\ldots\ldots (3)$$

In which great care must be taken to use the correct plus and minus signs. In railway work, this is much simplified by having all the area above the axis $XX.$, and in very irregular areas, which are met with in cuts that have slipped in as in Fig. 79, the area can be quickly taken out, thus, as follows:—

$$\text{Section} = \frac{+8.0}{-22.0}\cdot\ \frac{+8\,5}{-3.0}\cdot\ \frac{+8.0}{0\,0}\cdot\ \frac{+7.5}{+2.0}\cdot\ \frac{+6.0}{+8.0}\cdot\ \frac{+7.0}{+20.0}\cdot$$

$$\frac{+3.0}{+13.0}\ \ \frac{+0.0}{+9.0}\cdot\ \ \frac{+0.0}{0.0}\cdot\ \ \frac{+0.0}{-9.0}\cdot\ \ \frac{+2.0}{-14.0}\cdot\ \ \frac{+4.0}{-16.0}\cdot\ \ \frac{+8.0}{-22.0}$$

$$\text{Area} = \tfrac{1}{2}\{-24.0 + 16\,0 + 60.0 + 120\,0 + 91.0 + 27.0 - 32.0 - 88.0 + 128.0 + 56.0 + 18.0 - 60.0 - 56.0 - 12.0 + 24.0 + 187.0\} = 227.5 \text{ square feet.}$$

Thus arriving at a c rrect result without plotting sections, and by a mechanical sort of process, which is a safe one to place in the hands of a comparatively unintelligent rodman; for the purpose of checking calculations, it is not appreciably more or less rapid than by taking out areas by method. (2)

QUANTITIES.

The use of tables and diagrams is a great aid in taking out approximate quantities, so that in various handbooks may be found the volume of 100 foot prismoids of level sections, of various heights, slopes and widths of road-bed, and this has been extended in Wellington's earthwork diagrams, etc., by giving the volumes of 100 foot prismoids where the sections, although not level, are of the three-level type, having a separate height at the centre and each slope stake, and as in easy sections this is all that is taken the diagrams are very useful. More accurate calculations of volumes of excavation or embankment may be made in three ways: (1) The prismoidal formula, which is the only one that is mathematically correct, is as follows:—

$$\text{Volume} = L \times \frac{A + 4A_1 + A_2}{6} \quad \ldots\ldots\ldots (4)$$

Where L = length of prismoid A and A_2 = end areas and A_1 = middle area (which must be calculated by interpolating the middle heights).

A proof of this formula may be found in any mathematical text book, but a neat adaptation of the formula for three-level sections is given by Mr. G. H. White in *Engineering News*, April, 1895 (see Fig. 80).

$$\text{Volume} = \tfrac{1}{6} L\left\{A + 4A_1 + A_2\right\} =$$

$$\tfrac{1}{6} L\left\{\left(\frac{W.d}{2}\right) + \left(\frac{b}{2} \cdot \frac{H+h}{2}\right) + \left(\frac{W_2.d_2}{2}\right) + \left(\frac{b}{2}\frac{H_2+h_2}{2}\right) + 4\left[\tfrac{1}{2}\left(\frac{W+W_2}{2} \cdot \frac{d+d_2}{2}\right) + \frac{b}{2}\left(\frac{\frac{H+H_2}{2} + \frac{h+h_2}{2}}{2}\right)\right]\right\} \quad \ldots\ldots (5)$$

$$= \tfrac{1}{6} L\left\{\left(\frac{W.d}{2} + \frac{W.d}{2} + \frac{W.d_2}{2}\right) + \left(\frac{W_2 d_2}{2} + \frac{W_2 d}{2} + \frac{W_2 d_2}{2}\right) + \frac{b}{4}\left(H + H_2 + h + h_2 + 2H + 2H_2 + 2h + 2h_2\right)\right. \quad \ldots\ldots (6)$$

$$= \tfrac{1}{6} L\left\{W\left(d + \frac{d^2}{2}\right) + W_2\left(d_2 + \frac{d}{2}\right) + \tfrac{3}{4}b(H + H_2 + h + h_2)\right. \quad \ldots\ldots (7)$$

and if we have a definite slope which we call s. (say $1\frac{1}{2}$ to 1 for earth, or $\frac{1}{4}$ to 1 for rock), we will have

$$H + H_2 + h + h_2 = W + \frac{W_2 - 2b}{s} \quad \ldots\ldots (8)$$

and the volume equation becomes

$$= \tfrac{1}{6} L\left\{W\left(d + \frac{d_2}{2}\right) + W_2\left(d_2 + \frac{d}{2}\right) + \tfrac{3}{4}\frac{b}{s}\right.$$

$$(W + W_2 - 2b) \quad \ldots\ldots (9)$$

from which it will be seen that the volume may be obtained by having the slope stake distances of the two end sections (W and W_2), the centre cuts (d and d_2) the roadbed width (b), and slopes (s), thus eliminating the determination of the middle area from the calculation.

(2) Mean areas, which custom has established as the one to be ordinarily used, because of its simplicity, is merely, volume $= L \frac{A+A_2}{2}$ .....(10)

where A and A_2 are the two end areas, the error involved in this formula is $+ \frac{1}{6} L (h-h_2)^2 s$. Where h and h_2 are the two centre heights, and s = slope of earth work, it is evidently = zero when $h=h_2$ and increases with their difference.

(3) Middle area volume is given by

Volume $= L+A_1$ .....(11)

Where A_1 = area of section midway between the ends of the prismoid.

The error involved in this formula is $+\frac{1}{12} L(h-h_2)^2 s$, being one-half as much as in the formula for mean areas, and also disappearing.

When $h=h_2$—and although equation (11) is more accurate than equation (10), it is not used, because once the middle area has been determined, the prismoidal formula is easily applied and still more accurate. There is another reason why formula (10) is not objectionable, that, in general, the profile of a line is convex in cuts, and concave in fills, and any system of sections, no matter how carefully taken will, as an average, need a little allowance for this rotundity between sections.

At points where the cut changes to a fill there should be two grade pegs determined (see Fig. 76) and cross-sections taken at these points, this makes the first volumes in cut and fill always pyramidal, there is no necessity for a centre grade peg, unless the distance from one grade peg to the other is excessive.

Borrow pits should be carefully cross-sectioned from some well defined base line before excavation is permitted, and, if at all possible, it should be made imperative that these pits before being abandoned should be left in good shape for final cross-sections and for drainage; undrained borrow pits are unsightly, a menace to health, and difficult, often, of measurement. There is another matter in this connection which should be well attended to, *i.e.*, proper referencing of alignment hubs; this may be done by cross lines fixed by hubs, trees, etc., or by right-angled lines and steel tape measurements, but in whatever way accomplished, considerable judgment is required to place the references out of harm's way and at the same time reasonably available; in side-hill cross-sections made after excavation great precision is required in this respect to prevent serious error.

Article 29.—Methods of Payment and Classification of Materials, etc.

There are occasional instances of railway companies of some financial strength and progressive growth carrying on construction under their own management, with their own plant and by day labor, but such instances are not frequent, and in general we may look to responsible contractors for the rapid execution of this kind of work requiring experience, undertaking risk, and with considerable capital as plant continually wearing out. Occasionally such work is taken by contractors at so much per mile, within limits of curvature, grades, style and locality, but as the element of risk is great the price is correspondingly high. Only approximate estimates are furnished, and the experienced judgment of the contractor to size up the class of material to be met with is his chief reliance. Such contracts are apt to be made when the railway company and the contractors are more or less identical.

Again, at times, contracts are taken in which such as timber, stone and iron are specified as to quality and price *pro rata*, but the excavation is unclassified and an average price per cubic yard is given, the contractor again taking chances, and being, by this method, unable to alter the location, his risk is great and price high enough, on the whole, to cover the risk; this has led to what is, at present, the general method of letting contracts for excavation, namely, to define certain classes of material as rigidly as possible and fix prices for each class, the usual divisions are solid rock, loose rock, hard-pan and other cemented material, and earth. As the dividing lines between these classes are purely arbitrary they need to be defined for all possible contingencies, which is a difficult matter. An engineer is always, although in the employ of the railway company, more or less an arbitrator, and he should endeavor to be just to all; theoretically he should always live up to the strict letter of the contract, and ordinarily this is the only course to pursue, but there are cases in which contractors, in their eagerness to obtain contracts, take them at too low prices, or they may strike some very difficult cuts which will not classify very highly if the specifications are adhered to, and in such cases it is usual to allow percentage classifications based on a fair cost of doing the work, *e.g.*, a heavy cutting composed of a mass of small boulders closely cemented together would only classify as hard pan, but often must be excavated entirely by drilling and blasting, and in such a case percentages, at least of rock, would be quite justifiable.

This idea of *helping out* a contractor, however, is a very pernicious one, and should only be done for good cause, where the recipient is worthy of it by his economical handling of the work, and with full knowledge and consent of the railway company. The vigilant watch and full knowledge of the various classes of material met with in excavation and the most economical methods of handling them, form one of the most important duties that a railway engineer has to perform, needing, moreover, a knowledge of men as well as ways and means. The calculation of quantities in structures should be made very minutely and in detail, as the prices are so much higher per unit than those of excavation; but the method to be used will depend on the terms of the contract and the individuality of the engineer. In some cases payment is made on bills of timber furnished, and on general plans of masonry, while in others the actual timber used and the masonry as built are the basis of payment. In the case of timber this latter method should include payment, as timber delivered, for all pieces cut off either from piles or timber, so long as the material used was as per bill given.

Quantities of earthwork should always be measured in excavation, for no one can determine accurately the shrinkage of fills, especially as only a portion of it takes place while construction is in progress, and continues for a year or two depending on the method of forming the bank. The total shrinkage is fairly well known, being about 5 per cent. for sand, 10 per cent. for clay, and 15 or 20 per cent. for loam; while rock expands 50 to 75 per cent., depending on the size of the pieces, and such figures modified according to the age of the bank will be sufficiently accurate for monthly estimates, but not for final ones. It is more laborious, often, to measure irregular borrow pits, but by insisting on these pits being shaped up before being left, the extra labor is not so very great and is the only really reliable way, the chief value of embankment quantities being to aid in a proper dis-

tribution of material from cuts, to enable overhaul calculations being made, and for approximate estimates where errors of 5 per cent. or even more are not objectionable, as the company, in its monthly payments to contractors, reserves 10 or 15 per cent. for just such exigencies. In taking monthly estimates, the only certain method is to make each one a total estimate in fact as well as in name, and derive the current estimate by deducting the total one for the month previous from it, that is, never take notes only of what is thought to have been done during the month, for nothing is more difficult or more apt to lead to error—whereas if the total work done or material delivered at each point is noted, the errors of each month are eliminated in the next one—the extra labor involved in this is usually insignificant.

Specification for Excavation.—Materials excavated will be classified as earth, quicksand or dry hard-pan, loose rock and solid rock. Earth includes everything except the other classes mentioned. Hard-pan includes all cemented clay or gravel, or any combination of these that it is not practicable to plow with a four-horse team. Loose rock includes all stone containing not less than one cubic foot, and masses of detached rock containing not over one cubic yard; also all slate, shale or other soft rock which can be removed without blasting, although blasting may be resorted to. Solid rock includes all loose rocks containing over one cubic yard, and all rock in place which requires drilling and blasting.

(N.B—.The earth and hard-pan are sometimes placed in one class as earth, at a higher rate, thus saving much contention.)

ARTICLE 30.—SURFACE DRAINAGE.

In addition to the provision for flow of water under or through the track, there is yet the question of track and slope protection which is of almost equal importance. Where, on side-hills, the surface flow toward the top of the cut slopes and toe of the embankment slopes is considerable, ample provision should be made to intercept it. In general, catch water ditches three or four feet wide, and one to one and one-half feet deep, should be dug so as to run in a continuous line along the upper side of the cuttings and embankments from each lateral watershed to the nearest culvert or stream—which should set back five or six feet, generally, from the edge of the slopes leaving a solid berm; the material from these ditches, cast on the lower side will form an additional protection. In very porous soils, these ditches may need to be lined with pitch or planked; but in any case will prevent that heavy washing down of cut slopes which, otherwise, fills up the track ditches and floats the track, making the roadbed soft.

The track (cut) ditches themselves should be turned into these catchwater ditches at the upper grade points, so as not to empty down along the toe of the embankment, eating it away; and in very wet cuttings, it may be necessary to run a farm tile about three feet under the track ditches and parallel to them to aid the drainage. In case of quicksand, which will soon fill up tiles, the tile must be covered with straw and laid with collars, or longitudinal round pole drains may be substituted for the tiles.

The slopes of cuttings themselves also need protection to prevent erosion; in ordinary cases the sowing of grass seed on the slopes of cuts and fills will answer the purpose, but where the cut slopes are wet and springy it may be necessary, in addition, to cut a series of diagonal ditches on the slopes to bring the water to the cut ditches by easy grades; in extreme cases the construction of a network of tiles on the slopes may be necessary to effect complete protection. Perhaps the most imperative matter of all is to have the ordinary cut ditches always cleaned out—free from boulders, ties, ballast, etc., which tend to accumulate during maintenance. The form which such ditches assume is of a wedge shape, with a slope from the track of about 3 to 1 and an outer slope the continuation of the cut slope. This form will tend to maintain itself better than one with a flat bottom and steeper slopes.

(Conclusion Vol. I.)

For THE CANADIAN ENGINEER.

SEWAGE DISPOSAL THROUGH THE ACTION OF BACTERIA.

BY W. M. WATSON, TORONTO.

Toronto and several other cities and towns, as well as private places, are contemplating putting in sewage works. Perhaps a little information, gathered from the leading bacteriologists, chemists and engineers, who have with the assistance of the best appliances been studying and experimenting on sewage for the past fifteen years, with the object of solving the knotty problem, viz., how to purify foul fluids, may be useful. My own experience in this connection will also be of interest.

Up to the present time precipitants of lime, powdered clay, alumina, ferrozone, sulphurous powder, sulphate of iron, and other chemicals, have been used to clarify or clean sewage by settling in tanks, generally extracting about a twentieth part of a pound of sludge per gallon of sewage treated, at a cost per head of population ranging from 25 to 75 cents, and often having considerable difficulty in disposing of the solids, even when expensive pumps, presses, and other machinery are used. The average composition of domestic sewage is: organic matter, 27.72 grains per gallon; nitrogen, 6.21; phosphoric acid, 1.17, and potash about 2.03 grains per gallon, which is principally in solution, and can only be removed by filters that contain numerous colonies of a very small rod-shaped bacteria that can be seen only by the assistance of a very powerful microscope. These organisms feed and thrive on the foul contents of sewage matter. Trade sewage may contain any chemical, and in some cases may need special treatment, which ought to be given it before it is allowed to enter the public sewers. Sewage heavily charged with grease may require a precipitant of bisulphide of carbon. Sewage from sugar factories which contains vegetable organisms, oscillaria alba, or beggiatoa, which act like ferments, rapidly decomposing, may require a magnesium chloride, quicklime and coal tar preparation, to extract its foul contents, and sewage from slaughter houses should have the blood and fat extracted before entering the public sewers.

To discharge clarified sewage that has only passed through settling tanks into fresh water is simply undoing the work done, because the dissolved putrefactive matter is held in solution after the solids are thrown down by the precipitants, and after being delivered into fresh water the dangerous microbes increase rapidly, and putrefaction is set up. Almost the same end is reached by allowing the sewage to enter fresh water after it has been carefully screened through a fine sieve, and it is probably more to the advantage of the public to allow sieved sewage to go in raw, than after it has been settled by the use of precipitants, because precipitants add somewhat to the chemicals held in solution, and make the sewage harder to purify.

Sewage placed under a microscope shows various decaying matters, multitudes of dangerous microbes, amoebiform bodies, infusoria, fungi, etc., including all the classes discharged from the skin and intestines of man and the animals. When water carriage is used to remove

excrements, it is usual to calculate upon a basis of about 156 lbs. of solids and 200 gallons of liquids from each one thousand of population to remove daily. The sewage from clothes washing is very dangerous.

Disposal of sewage by broad irrigation over the top of land is neither efficient nor profitable in cold climates, because it takes a large space, and only about two gallons per yard per day can be put on, even when vegetation is active, because of the tenacity of the soil in holding moisture. Vegetation only takes up the manurial deposits, and the bacteria in the land must extract the foul gases or poisons, which they cannot do when the air cells of the earth get choked with fat and dirt. Then the bacteria cannot secure aeration, and so becomes useless. During heavy rains and hard frosts, the land is totally worthless as a filter or absorber of foul matter. When either irrigation land or artificial filters become water-logged too long they become asphyxiated, the organisms cease to act and oxidation is suspended until air can again be introduced to the filtrate to give vitality to the bacteria. On that ground irrigation through land can only be a success when the position is high and dry, and the water can freely escape at a depth of over four feet, and when it is composed of sand and gravelly soil. Under these circumstances, it will act as a bacteria filter, and can be made to purify sewage all the year round, by laying perforated pipes about every two feet, so that the fluid will be evenly distributed over the land. The pipes may be laid about fifteen inches below the face of the land, out of the reach of the frost in winter, and out of sight in summer, to prevent any nuisance, and to allow the land to be cultivated. By so doing, the moist air rising from the sewage will aid the vegetation growing on the surface. When this system is adopted proper arrangements must be made to discharge the sewage through the pipes at stated periods and equal quantities, giving the land periods of rest and sufficient time to secure aeration, and to supply the air to the underground pipes, flues and air circulating shafts must be constructed so that every part of the irrigating land, gravel and sand, also the microbes lodging in it, may be sufficiently supplied with oxygen. A firm in Ireland mix a solution of soda with the sewage, which it is claimed gives the bacteria all the oxygen they require without wasting time aerating. This is described elsewhere.

The marked success lately of the scientists has shown that all purification of foul fluids, whether accomplished by fresh water, by farm land, or artificial filters, is done by bacteria, and every method used to purify sewage must have proper provision made to supply these microbes with oxygen. By scientific management these friendly bacteria, which are humanity's scavengers, can be coaxed to eat up all the dirt and impurities in the sewage and discharge it into the atmosphere in the form of non-injurious gases, and by so doing saving the expense of handling the sludge.

This narrows down the art of cleaning foul fluids into being able to cultivate, to breed and use friendly microbes to advantage. When this is accomplished and the ditritus screens, the preparative storage tanks and the bacteria filters stocked with the friendly microbes and set in motion, it afterwards costs little to manage the treatment plant, for it can be made fully self-acting, only requiring the ditritus removed from the screens, and the grit removed from the syptic preparing tank about once a year.

There are several sewage purifying works constructed on the system just described working at present, and it will no doubt be generally adopted when properly understood. What is named the syptic tank, is placed underground and arched over, made air-tight and kept dark. The town's sewage goes in at one end and is almost motionless for a day, and during that time the coarser particles in suspension become deposited, and the putrefactive bacteria contained in the sewage are disintegrated, and a large portion of the inferior microbes disappear along with the sediment, after which it overflows over the opposite end, and is passed on to the bacteria filters.

Where convenient, towns should have separate drains for the collection of sewage, and they ought to be divided into small districts, each having its own sewage works. By adopting this plan only small main sewers would be needed, a better grade could be given, the sewage would arrive at the works in a fresher state, and on that account would be easier to treat, it would not have time to putrefy in the pipes, and the sewers would not need so much flushing, and the large trunk sewers might be dispensed with. By the new method of sewage purification the district plan can be easily carried out, because the whole sewage plant can be placed underground in public squares or other convenient places, out of sight and totally free from smell or nuisance, there being no machinery required or sediments to remove, and the first expense of plant will be less than by the old systems, and the cost of management after the system is put in full working order will be very small.

When proposing to lay down a sewage disposal plant there need be no stereotyped rule, nearly every place will require a little different method of arrangements in detail. The difference in the composition of the sewage, the geographical position and surroundings, and the amount of depth applicable, will each need to be considered in the style of construction. The general points to be secured are, first, that when a filter is started it must be stocked with sufficient colonies of the friendly bacteria ; second, see that they are supplied at short periods with plenty of oxygen by a thorough aeration of the filter ; third, never allow the filter to empty with a rush, because in that case some of the bacteria would be washed out of the filter. Rush the sewage on as quick as you please, but draw off the effluent slowly. Never allow the filter to be water-logged longer than the microbes can exist under water on the store of oxygen that is in the air cells of the filtrate and the little there may be in the fluid. Where possible to secure carbon made by carbonizing towns' garbage, use it for a filtrate. When these instructions are adopted the plant may be made to any design and placed in any position, either open or buried underground, and the results will depend on the amount of scientific management and good workmanship introduced into the construction, as to whether 200 or up to 500 gallons of sewage per superficial yard of filter space can be run through each day.

I have already described the preparatory settling tank into which the sewage first enters for treatment after being freed of all ditritus. The bacteria filter that purifies the fluid is simply a separator, that divides the sewage into small particles, and also constitutes a residence for the millions of bacteria which are brought into contact with each particle of sewage, on which they feed and from which they extract the foul gases. Any handy material that is easily wetted and easily dried and cannot be dissolved by chemicals, will answer for the filter, because it is not so much the nature of the filtrate, as it is the size, the thickness and the arrangement of the material in the filter, that is of the first importance. The best material is that which contains the largest amount of air cells to the cubic inch, in which the oxygen can be stored when the filter is getting aerated. Carbon is preferable because it is a better non-conductor than gravel, it also possesses the most air cells and is a natural deodorizer. Thus,

either charcoal, carbon made from garbage, coal, spar, marble or gravel chips, clinkers, slag, sandstone, gravel, coarse sand, hard burnt clay or cinders will answer to charge the filter with.

If there is about 20 feet of depth between the bottom of the outfall sewer and the high-water mark of the fresh water channel into which the clear effluent is intended to be discharged, a free hand can be used in the construction of the works to the advantage of the paymasters; but if there be only five feet between the two points, a plant may still be made to work without the aid of pumps or other water lifting machinery. In places where there are combined storm-water and sewage sewers, it is unnecessary to treat sewage when a violent rainstorm is on, except that portion which is forced forward at the first rush, and which is really the scourings of the drains, because when 25 per cent. of sewage is well mixed with 75 per cent. of fresh water it becomes harmless, because the bacteria that are always in fresh water are in the ascendant, and will devour the small amount of foul matter the sewage contains. But when sewage is emptied into fresh water without being properly mixed and shaken up, it holds itself apart, and the *bacillus coli communis* and fecal microbes rapidly breed and thrive with the help of the adjoining fresh water, and resist the attacks of the scavenger bacteria by keeping in a compact body.

Filters can be constructed so that a constant current of air will flow through the body of the filtrate, simultaneously with a flow of sewage continually passing on and downward through the filtrate; and where the space is limited and room for a syptic tank cannot be secured, then in place of the dark syptic tank an upward flow roughing filter composed of crushed clinkers will answer for the preparatory process.

I have recently received the plans of a very simple and inexpensive mode of purifying sewage that is continuous in action, and requires no sieves, or screens, or any attention. If the sewage is weak because storm water gets a little mixed in, it goes through a little quicker to make up for it. It is well understood that it is the top twelve inches of a filter that does the work, and that there the bacteria slime rests because it is there where the air can be got the easiest, so the inventor forces the sewage in at one end of the filter and it moves along under the surface to the other end and passes out, thus the bacteria can secure air from the dry surface at any time.

There are a great many expensive sewage-disposal works now in use that discharge their finished effluents in a state that cannot be purged of the putrefactive matters that are held in solution, and that contain many colonies of active and dangerous microbes. These impure effluents are either discharged unfiltered, or are passed through filters which are rendered useless by the fact that they are never aerated.

For THE CANADIAN ENGINEER.

THE OXYGEN SYSTEM OF SEWAGE PURIFICATION.

BY W. M. WATSON.

The Sewage Purification Company, of Dublin, Ireland, has been good enough to send us a small pamphlet explaining their patented system of purifying town's sewage. There are several new features in the process worth noting. The company tells us that they use extra deep settling tanks, with sumps to collect the sludge, that they use baffle plates to throw down the solids, and that they supply the micro-organisms with the necessary oxygen they require by the use of nitrate of soda in place of and as a substitute for atmospheric air. They say that the oxidation of sewage is brought about by the operations of micro-organisms, and that the organisms which live on dead organic matters will quickly multiply in sewage, and will rapidly set up an oxidation of the organic matter it contains, making the sewage harmless if there is a regular and continuous supply of oxygen to all parts of the liquid under operation sufficient to sustain vitality during their life processes; and the sewage is preserved until acted upon in a neutral or slightly alkaline condition, and continued so during the activity of the organisms. When these conditions are maintained, several chemical changes take place. When the sewage passes through the first or roughing tank, the heavy solids are extracted; when passing through the second settling tank, the sewage, by the help of a precipitant, is converted into ammonia carbonic acid and water; and by the third and last process the ammonia is turned to nitric acid by microbes or bacteria. They say that they have succeeded in estimating the amount of air the microbes require to perform their work well. Thus, for very foul sewage, it takes 1,400 volumes of air to 1,000 volumes of fluid to remove the suspended matter, and even three times the bulk of air to one of fluid to finally and perfectly purify trade sewage. They point out that oxygen must be regularly supplied to the micro-organisms; if not, they will at once set up putrefaction, emitting offensive and dangerous odors. This would appear to mean that they hold that the intermittent method of aeration is a failure.

It will explain the remarks more fully by stating that the process of filtering is at present as far as sewage is concerned an artificial means of supplying the micro-organisms with oxygen. Therefore it is necessary to arrange appliances so that they will continually aerate every particle and item of the filtrate where the microbes that clean the sewage lodge. On this ground every description of filtrate must be open and porous, whether it be sand, crushed stone, clinkers, coke, fine pea coal or charcoal, and packed together in a way that will divide the sewage into small thin films that will move from one item to another on its downward passage through the filter, allowing the bacteria the filtrate contains to devour all the dead matter, also to allow a free passage of air to every particle of filtrate, so that the micro-organism it contains can be amply supplied with oxygen.

This so-called oxygen system consists of three processes, the roughing tank, then clarifying by a precipitant called manganese, often called Condy fluid, and the final process by the microbes, which are supplied with air or oxygen by the use of nitrate of soda without the help of filter beds, such as is described in the preceding paragraph, and that as thus far being in general use as a lodgment for the microbes and a medium for the circulation of air to supply them with oxygen.

The advantages of their system appear to be that by using nitrate of soda as a substitute for atmospheric air to supply the bacteria with the oxygen, they are able to sustain activity in a gradual and regular form, thus preventing any danger of the sewage setting up putrefaction during the process of purification. This, of course, assumes that oxygen can be properly supplied from nitrate of soda. The second advantage is that by using deeper tanks, baffle plates and nitrate of soda, they can keep up a rapid continuous flow through each of the three processes required, thereby purifying about 60 per cent. more sewage than can be done by other appliances used to mechanically purify foul fluids; taking only about one-third of space that other systems do for plant, having no expensive machinery pumps or fans, no tanks stand-

ing idle, aerating, etc. I approve of the idea of the deep tank and baffle plates; the soda business, also, if it is a genuine substitute for air, and can be efficiently applied at a small cost. I cannot approve the use of any precipitant, though manganese is one of the best precipitants that can be used, because the latest scientific experiments have proved that microbes and bacteria can totally destroy every impurity contained in sewage when properly aerated and housed in filters composed of powdered charcoal made from town refuse or small pea coal, and in a lesser degree by sand, small clinkers, stone and coke.

SOME MODERN FORMS OF MILLING MACHINERY.*

FREDERICK T. SNYDER, KEEWATIN, ONT.

The time has happily gone by when directors of mining companies order a mill "ready made" like a suit of clothes, and it is not unusual to have a mill designed to fit the ore it is to treat, as carefully as the development aims to explore the lead. The machinery, whose description follows, is a case where designing to meet specific conditions has been carried somewhat further than is customary. The problem was to plan a custom plant to handle the gold ores of the Lake of the Woods, many of which are low in grade, but contain streaks of high values. The absence of copper or lead in addition to the low tenor, put smelting out of the question. A site was selected at Keewatin, having ample water power with the lake for a mill pond. The ore is brought in from the mines to the plant in barges carrying thirty tons. It was decided to build the mill, to unload this ore, crush it, and sample into storage, then run over amalgamated plates and vanners; all the ore handling to be automatic. It will be seen in the following description that nothing radical was introduced, and that the principal features worth noting were improvements in the detail of existing methods.

The ore is unloaded from the barges by means of a Locke-Miller cableway of four hundred and fifty feet span. This hoists the ore in skips to an elevation of seventy feet and carries it across the main line of the Canadian Pacific Railway into the sampler building. The skip is automatically dumped into a two hundred ton bin, by means of a spring hook. The bottom of this bin is shaped like the letter W, having a gate at each point, so that each side may be used as an independent bin. Both discharge into a crusher feed hopper in the form of an iron cone, thirty inches in diameter at the bottom, placed with the open end thirty inches from the crusher feed floor. The gates being open the ore forms a cone on the floor around the bottom of the hopper, and automatically works down as it is fed into the crusher.

This crusher is of the "Invincible" type. Tension strains are carried by wrought iron, and all compression strains by cast metal. The movement of the jaw is parallel, the top and bottom moving equal distances; and not, as in the Blake, where the bottom moves more than the top; or, as in the Dodge type of crusher, where the top has the greater throw. The usual arrangement is reversed and the outside jaw made movable, with the result that the common massive frame is done away with. This brings the weight of a ten-inch by eighteen-inch machine, which is the size used in this plant, down to nine thousand pounds, while the customary weight of the cast-iron framd machine of the Dodge or Blake type is from twelve thouse and pounds to eighteen thousand pounds. Each portion of the jaw moves over an elliptical path, the long axis of which is so inclined that during the moment of crushing the hanging jaw plate moves directly towards the stationary plate, and only at the end of the stroke moves down and back to feed the material through. The result is a minimum amount of cutting of the plates by the ore, there being no sliding movement at the time of greatest pressure. The tension strains are taken by four wrought rods, which run through the frame of the machine to the rear and end in nuts. By tightening independently the rods holding the top and bottom of the hanging jaw, the inclination of the moving plate with reference to the fixed one can be altered. It is profitable to have the opening of the crusher as large as possible, that sledging may be avoided, while the angle between the jaws must be so sharp that the rock will not jump up when the jaws come together. These independent adjustments allow the angle between the jaws to be the largest practicable for any particular ore, and once placed, does not change during the operation of the crusher. In the design of this machine the parts which require attention have been concentrated at the back, so that the jaw end can be built into the feed floor, placing the jaw opening where most accessible, and at the same time bringing together within easy reach and out of the dirt and dust from the ore all oil cups and adjustments requiring attention. The inertia effects in this machine were planned to make it as free as possible from longitudinal shake, and in this plant, where it is set twenty feet or more from the ground, produce little or no vibration of the building.

The ore from this crusher is carried by bucket elevator to a screen, which deserves especial notice, its use removing the list of troubles attendant on handling crushed quartz dry through a revolving trommel. It is an ordinary gravel screen, set up at an angle of forty-five degrees, and furnished with a cover. But it is this cover that makes the difference, as it prevents the ore from taking long jumps, and thus permits the use of a screen of almost double the mesh of the product desired. That is, to get half inch mesh ore use a one inch screen, the ore particle striking the screen at so small an angl as not to fall through if more than two-thirds the size of the opening. Particles of ore which get wedged in an ordinary screen do not get into the openings of this screen at all, but jump down over it to be further crushed. The screen surface used in this plant is five feet long and ten inches wide, and readily handles six tons of ore per hour.

What fails to pass the screen goes to a pair of rolls, in which the best results of the experience of a number of mining machinery designers have been utilized. These rolls having shells thirty-six inches in diameter and ten inch face, weigh twenty-six thousand pounds, and when taking rock from a three inch screen and crushing to half inch mesh, run smoothly without jar. The frame is cast in one piece, extended below to form a hopper. The moving roll is of the sliding yoke type. The bearings are nine inches in diameter by twenty inches long, and are patterned after the journals of a railroad axle, which seems to be the best type for heavy service under repeated strain. They have a solid shell and are babbited on the side supporting the strain. The other half is chambered out to form a recess to hold waste, soaked with oil. In addition, back of the babbit is cored out a water jacket, which, in the event of heating, can be connected by hose with the water supply, and the operation of the rolls continued. The shell on the outside is but partially formed in the shape of a ball and socket box. It allows the box to adjust itself to any horizontal angularity of the shaft, such as is produced when one side of the roll is fed an the other side is empty, but prevents the

*A paper read before the Federated Mining Institute, Montreal

shell from tipping out of a horizontal plane so that the babbit in one end of the bearing cannot wear out without wearing out the other end at the same time. These bearing shells are supported in yokes, which, in the case of the movable roll, form the sliding part, and in the fixed roll are cast in the frame. By removing the caps of the yokes a roll, together with its bearings, can be lifted out at any time for repairs without disturbing the tension of the springs. One bearing of each shaft is furnished with collars on both ends, each of which, in the case of the ten-inch by thirty-six inch roll used in this plant, has a bearing surface of two hundred and sixteen square inches. Between these collars and the ends of the box are loose brass rings, making the total thrust bearing surface in each direction, on each shaft, four hundred and thirty-two square inches. These collars are threaded upon the shaft, and by screwing them in or out the shaft is adjusted endways to keep the rolls in alignment. The housing above is a prolongation of the frame furnished with openings covered with canvas curtains, making all dust tight. The shaft of the moving roll passes through sliding plates, which are held against the housing by springs. All the principal nuts on the machine are split and provided with clamp nuts, so that they can be securely held in adjustment, yet readily be loosened for movement. In operation, the rolls are set apart by means of cast-iron plates, against which the sliding box is screwed up solid. When running it does not jump. Each yoke of the sliding boxes has a bearing surface under it twenty inches wide by thirty-eight inches long, in the form of a steel plate two inches thick, removable when worn. To provide against the accidental introduction of a piece of steel too large to go through the rolls, safety springs are provided, which, however, do not yield until the pressure per lineal face of roll exceeds four thousand pounds, giving a spring pressure for this size of roll of forty thousand pounds, which will flatten out a wrought iron nut, but will allow a cold chisel to go through. The feeder for these rolls has no moving parts, but consists of a series of four inclined steps facing in opposite directions, from one to the other of which the ore slides, and is so spread evenly over the width of the roll shells. One of these steps is hinged, and by means of a short lever can be thrown up against the step above it to shut off the ore supply in case of trouble with the rolls or with the spouting above.

That portion of the ore passing through the screen goes to an automatic time sampler, which was designed for this plant. It consists of a casting about the size and shape of a miner's gold pan which is mounted to revolve on the end of a horizontal shaft. The ore to be sampled is allowed to fall on the inside of the sloping flange, and slides off into a receiving bin. At one point of the sloping flange is a narrow slot, which, as the sampler revolves, passes under the spout and allows a portion of the ore stream to pass through to the back of the sampler into a second bin, where it forms a sample of the lot. This sampler was designed to avoid the mechanical complication of the Bridgeman sampler, which was recognized as doing theoretically correct work. An attempt was also made to reduce the head room necessarily occupied by a sampler, with the result that the seven feet required for a Bridgeman sampler of the same capacity, has been reduced in this machine to twelve inches. It is probable that this machine, while making but one cut on the material, does theoretically the same work as the Bridgeman, which makes three.

From this sampler the ore drops into one of two three-ton hopper scales, where it is weighed and delivered by flat belt conveyor to one of the two hundred ton storage bins. When required for reduction it is drawn off from the bottom and carried by another belt conveyor two hundred feet into the stamp mill. These are flat belts, twenty inches wide, eight ply rubber, running at a speed of three hundred feet per minute, and have proved entirely satisfactory. The surface wears but little, the ore being given the same forward velocity as the belt, before it is allowed to drop upon it. This belt has carried over sixty tons of ore per hour on a space not over eight inches wide in its centre. The belt goes uphill and delivers the ore into the ore bins above the stamps.

From these it is fed by automatic feeders of the suspended "Challenge" type, which are without the usual frame and hopper, the disc with its rotating mechanism being hung on two iron bars at the back of the mortar. A light iron spout connects it with the ore bin gate, and the ore bin proper forms the hopper, thus giving free access both to the back of the mortars and to the mechanism of the feeder.

These deliver ore into the mortars, which were designed solely as crushing machines intended to give a maximum output when fed with ore which has passed a half-inch screen. They are double discharge, provided back and front with splash boards. The discharge from the back screen is carried through a channel cored out in the base of the mortar so as to issue, together with the discharge from the front screen, through a short spout on the front of the mortar. These mortars weigh six thousand pounds apiece, the base being ten inches thick. They are furnished with steel liners on the sides and ends, and the wear of the shoes compensated for by false bottoms of steel. The screens stand at an angle of seventeen degrees from the vertical, and are twelve inches by fifty-two inches, giving a total discharge area of twelve hundred square inches. The stamps dropping in these mortars weigh nine hundred and fifty pounds each, and drop eight inches one hundred times per minute.

The pulp passes from the mortar to the distributing box of a gyrating copper plate, four feet long and six feet wide. These are silver-plated, coated with amalgam, and by a simple mechanical arrangement each point in the surface of the plate is caused to gyrate around a circle about three-quarters of an inch in diameter. This causes each particle of ore, in place of running over a straight path of amalgamated copper six feet long, to go over a spiral path about thirty-four feet long, before it reaches the bottom of the plate. The gyrating shake enabling the table to be operated at about one half the incline necessary without it.

From these plates the tailings pass to vanners with four feet plain belts. These vanners, in place of the customary side shake of the "Frue," are given the same gyrating shake as the plates, that is, each point in the belt moves over a circular path about three-quarters of an inch in diameter. The reason for this circular shake in place of the customary side shake of the Frue vanner will be apparent to anyone who has attempted to settle the contents of a gold pan; or in a hand screen, has tried to get the coarse material on top. The advantage of this shake is so apparent, that the question arises, why it has not been used before, especially as it was patented some seventeen years ago in the United States. The difficulty has been to build a practical machine that would not shake itself to pieces under the varying strains brought about in producing this gyrating motion. Success was obtained in the vanners of this plant by stripping them of the customary heavy frame, supporting them on six round

steel rods, one end of which was screwed to the floor, the vanner resting on the upper end free to float around in any direction. The belt is stretched over rollers in the usual arrangement and below it is supported, on a short vertical shaft, an unbalanced weight. When this weight is caused to revolve by a two-inch belt the amount that it is out of balance causes the vanner to swing around in a circle, whose radius multiplied by the weight of the table equals the radius of gyration of the unbalanced weight multiplied by the amount that it is out of balance. In practice it has been found desirable to use a gyration about three-quarters of an inch in diameter, and to run the table at a speed of about two hundred and twenty-five shakes per minute. Owing to the fact that the table is just balanced by the amount the gyrator is out of balance, no jar or shake is transmitted to the floor, and no racking strain is set up in the vanner itself. The feed of the belt is obtained from a Challenge feed clutch on the head roll. The tail of this clutch is attached by a flexible link to a point on the floor, the gyration of the table furnishing the necessary movement. By changing the point of attachment of the link to the floor, the feed of the belt can be altered from nothing up to twenty-five feet per minute. The heavy frame of the Frue vanner, the side shaft with its three eccentrics, and the complicated "G" spring feed is avoided. From the vanners the tailings are divided over two more sets of gyrating copper plates, each four feet wide by six feet long supported in a similar manner on flexible steel rods, and gyrated by the revolution of an unbalanced weight supported below each.

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THE PUBLISHERS.

THE D'ESTE AND SEELEY COMPANY'S STEAM TRAPS.

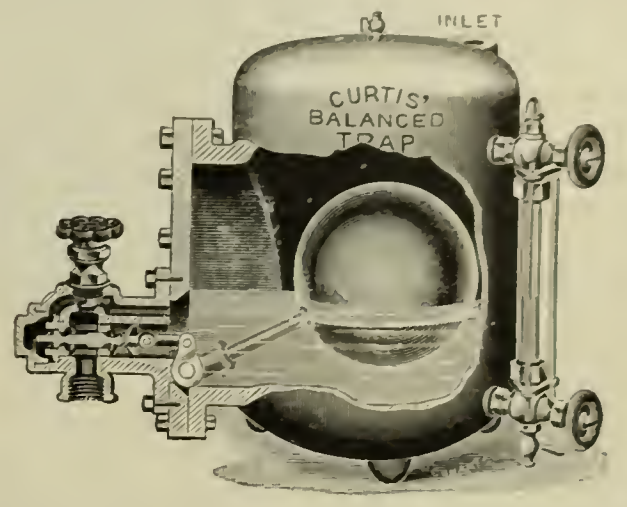
Every high pressure heating plant or any heating pipe not returning to the boiler should not be allowed to run a moment without a steam trap. No sane man would think for a moment of opening a pipe direct from his boiler to the atmosphere and try to get steam, and yet that is just what is done when a pipe is not drained by a trap. The amount of money wasted in this way on an ordinary steam plant in one season would pay for traps enough to last for years, and thus be one of the very best instruments which the owner or engineer could possibly make. While any trap is far better than no trap, it is always well to remember that a good trap costs little, if any, more than a poor one, and a purchaser with a little care in making a selection can assure himself that he is getting the best the market affords.

Four things should be required: First, efficiency; second, simplicity of parts; third, durability; and fourth, ease of making repairs when necessary. In all four of these points the Curtis balanced trap stands high, as may be seen by the following description:

The full prospective view shows a cylindrical pot with rounded ends, of the strongest form to resist pressure. On the side is a neck or nozzle of sufficient diameter to admit the float. This nozzle is covered with a strong plate, to which is bolted the composition valve. It will be seen that when the plate is removed it brings away the float and valve with it, which can be taken, altogether, to any suitable place to be examined or repaired, or can be shipped to the manufacturers, leaving the pot in place and connected.

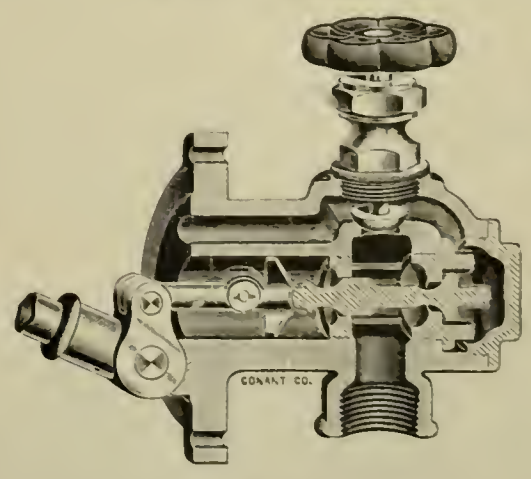
The composition valve can be removed without removing the cover, by taking out the four tap bolts by which it is fastened; then the float steam can be pulled out far enough to unscrew it from the knuckle, leaving the float inside and cover joint intact.

The sectional view shows a valve body cast with strong ears to bolt it on to the cover of the trap. The valve consists of two discs of equal area on a single stem, one with



a short sliding fit, and the other with a ground seat taper fit, which guides it onto its seat, while the valve stem is guided by a spider with three arms, and is loosely connected by a knuckle joint and stem to the float. The valve stem is in two parts, the outer one carrying the discs screwed into the inner one; and when unscrewed the valve can be taken out for repairs or grinding.

By removing the cap from the end of the valve body, the valve can be taken out without starting a joint, pipe, bolt or gasket. This is claimed by the makers as an entirely new, as it certainly is a valuable, form of construction. It is also provided with an independent passage or passby, and is the only trap, so far as known, with the valve so easily accessible from the outside. It is also provided with an independent passage or passby controlled by a stop valve, and work can be continued and the water drained off, even if the discharge valve should remain closed for any reason. The float is very large, perfectly rounded, so hard that it cannot be dented, nor can it be collapsed at 200 lbs. pressure. It is made by a special process of an alloy with aluminium, and is practically indestructible. It is hermetically sealed as a glass globe, and is so located in the trap that the outlet is always sealed by several inches of water.



These steam traps have acquired their reputation in the last eight years simply on their merits. This is presented as a strong, plain, serviceable machine, and is warranted to work correctly under any disadvantage to which a steam trap can be subjected. They will work against any head or back pressure less than the direct pressure in the trap. Some of them are now working with 75 pounds in the trap, against 30 pounds pressure on the outlet, and deliver hot water into the second and third story or into a closed tank.

The Curtis balanced trap is also often used as a water-line trap on large plants, when there is need to balance any particular circulation, to prevent snapping and cracking in the pipes and radiators. This is accomplished by connecting the direct steam-pipe to the top of the trap, and bringing in the return below the water line of the trap.

MONTREAL ISLAND BELT LINE RAILWAY.

The Montreal Island Belt Line Railway, about thirteen miles of which was opened for operation during the past year, constitutes perhaps one of the most significant facts of recent years in connection with the development of the commercial capital of Canada. At the time the North Shore Railway was being constructed between Montreal and Quebec, great pressure was brought to bear upon the Government to bring it across the Riviere des Prairies at Bout de l'Ile, and thus traverse the Montreal Island to the city of Montreal. For reasons, apparently political, this influence was disregarded, and the North Shore Railway was brought into the city via St. Martin's Junction, thus adding fifteen unnecessary miles to the length of the line. The lower part of the Island, which comprises its best half, covering a distance of about thirteen miles, consequently remained in a large measure inert, until a year ago, when operations were begun by the Belt Line. This seems to be the beginning of the much-talked-of scheme to girdle the Island, a charter for which is held by the Belt Line Company.

In 1897 the old Belt Line Company was reorganized, new blood and large capital brought into it, and operations begun on a vigorous scale. Although the charter is for the construction and operation of either a steam or electric railway, the directors judged it in the interests of the company to make use of the latest developments of electricity as a motive power. The construction of the line was pushed rapidly forward in the face of great difficulties in the way of land expropriations, and the line was opened for traffic a little more than a year ago.

The line is thoroughly constructed, on the standard gauge, and specifications of the Dominion Government railways. It has its own private right-of-way, constituting a strip of land eighty feet in width, the whole distance. It is almost a straight line from one end to the other, and with the single exception of the Canadian Pacific Railway at Hochelaga, its gradients are practically level. The line leaves the Canadian Pacific Railway at Hochelaga, and passing near the proposed Inland Basin, traverses the municipality of Maisonneuve, Longue Pointe and Pointe aux Trembles. Where the line crosses La Salle street in Maisonneuve, an extension is built along La Salle street (one of the principal streets in the town) to Notre Dame street, crossing on its way the tracks of the Montreal Street Railway at Ontario street, St. Catharine street and Notre Dame street. The Town Council of Maisonneuve, alive to its own interests, secured this concession from the Belt Line Company by granting them a perpetual franchise of the street in question and exemption from taxation for a long term of years. In its course through the municipality, the line passes close to several large manufactories, to which sidings have been laid by the company. Passing through the municipality of Longue Pointe, it runs within a few hundred feet of the immense Asylum for the Insane, which is now in course of construction.

It may not be known by everyone that the extensive Longue Pointe Asylum, which has existed for many years near the banks of the St. Lawrence in Longue Pointe for the care of an unfortunate class of the community, is about to be removed to a more suitable location, about a mile and a half further back on the same property, where the buildings will be reconstructed on an immensely larger scale than ever existed before, and that to this end the Quebec Government guaranteed a loan of $500,000 at a low rate of interest. The buildings of the new asylum are in the course of construction, and when completed will constitute almost a town of themselves.

From Longue Pointe the line of railway pursues a perfectly straight course to Pointe aux Trembles, a most flourishing and attractive suburban village, situated about six miles from Montreal. Since the advent of the railway building, operations in the village have been very active, and there is every prospect of a most prosperous time for the village. From Pointe aux Trembles the line turns slightly to the left, and following the course of the St. Lawrence River, and in full view of it, it reaches Bout de l'Ile, a distance of another six miles, passing on its way the Catholic convent at Pointe aux Trembles, and the French Protestant Training School.

A Straight Bit of Track.

At Bout de l'Ile, where the cars are connected by a steam ferry with the town of Charlemagne and other points, a large park has been established by the company, covering more than twenty-five acres. Bout de l'Ile ("the end of the Island") is an ancient hamlet, beautifully situated at the "meeting of the waters," where the Ottawa (Riviere des Prairies), merges into the blue St. Lawrence. The company has transformed this dreamy hamlet into an ideal summer resort. Its charming grove of maples and elms has been turned into a picnic ground, and ample pavilions, band stand, boat-houses and bath-house put up. A bicycle track has also been laid out around the park, to form at no distant date an important feature in the plans of devotees of the wheel in Montreal. The large hotel overlooking the two rivers has just been purchased by the company, and plans have been made for a big extension, which is to be ready for occupation by the Queen's birthday. The idea is to provide first-class accommodation and harmless and amusing diversions for the citizens. The hotel grounds will comprise 330,000 sq. ft. of land, and the new building will have a dining-room 36x60 ft., and a billiard-room 20x50 ft. The grounds will have fountains, tennis lawns and croquet courts. That the susceptibilities of temperance people may not be offended, the bar will be kept away from the hotel building altogether.

The company, in equipping their line, made a new departure from what has seemed to be the established custom in Montreal. The cars placed upon the road are of the best description, finished inside and out of imported mahogany, oiled and polished. The cars, instead of being the orthodox one-truck, were equipped each with double Taylor electric trucks of the latest construction. Inside they are luxuriously upholstered and polished, while the unsightly stoves of some electric railways have vanished, and each car is heated with six electric heaters of the latest description. They are handsomely vestibuled at both ends, and brilliantly lighted. These cars can only be compared to Pullman coaches on a smaller scale. The open cars, so much appreciated by summer travelers, are likewise built and finished in the handsomest possible manner. They are forty-five feet long, also double trucked with the Taylor Electric trucks. One of the open 45-ft. cars is shown in the accompanying engraving.

The company has also placed upon its line an electric locomotive, built to handle ten loaded cars. This latter move was made in order to meet the demands of the trade in the lower part of the city, connections having been made with the tracks of the Canadian Pacific Railway. A satisfactory arrangement was made with the latter company and the Belt Line for switching the East End freight coming over the Canadian Pacific Railway and destined for points in Maisonneuve, Longue Pointe and Pointe aux Trembles, and the end of the Island, in car lots.

An electric rotary plow has been in operation all the winter, and has performed most efficient work. The snowfall of the past winter is well known to have been one of the most severe in the memory of man, and on the occasion of the most severe

of these storms, when all the steam railways in the country were tied up for three, four and five days at a time, the rotary plow of the Belt Line opened the line up from one end to the other inside of five hours. At places the drifts of snow were so deep that the upper part of the drift had to be removed to permit of the egress of snow from the machine as it was discharged in a continuous and rapid stream from the vents.

Double Truck Car.

The power-house of the company is built about half way between the two ends of the line, near the village of Pointe aux Trembles. It is situated on the edge of the St. Lawrence, and a wharf has been built at this point out into the stream. Two large car barns have also been erected, besides other minor buildings, and as this point is connected with the main line by a short branch of a few hundred feet, there appear to be excellent

Rotary Snow Plow.

facilities for ultimately bringing car-lot freight from Montreal, destined for shipment, and here transferring to the vessels. The company before deciding upon its equipment investigated all the latest improvements in electricity, and canvassed the various electric manufacturers in Canada and the United States. The decision arrived at, and what has been carried into effect, was to install three compound condensing Wheelock engines, aggregating over seven hundred horse power, belt connection, and two electric dynamos, one of 200 kilowat, and the other of 325 kilowat. The contract for the engines was given to the well-

A View in the Park.

known makers, Goldie & McCulloch, of Galt, Ont., and was carried out in a highly satisfactory manner to the railway company. The engines are models of perfection, grace and easy working. They are placed on massive masonry foundations, and when revolving at a high rate of speed, so slight is the vibration that a copper cent can be set upright on its edge on the curved surface of the cylinders and remain there indefinitely without being overturned. The engines are divided into three units, two of 150 h.p., and one of 435 h.p. By thus dividing the units, the power for every varying condition of traffic upon the company's line is made to correspond with the consumption of fuel. So economically are these engines built and graduated that during last year's operations the consumption of fuel, repairs to motors, engines, boilers and generators, all included, amounted to less than 2 1-3 cents per car mile. The makers appear to have surpassed their usual excellence of work. The contract for the large electric dynamos was given to the Canadian General Electric Company, of Peterboro, and has been filled in an equally satisfactory manner. These machines will develop as high as 900 h.p. between them, and their regular rated capacity is nearly 700 h.p. At times during the past summer work upon the line was very heavy indeed, notwithstanding which no defect of any kind discovered itself in these magnificent machines. The motors for running the cars were also obtained from the Canadian General Electric Company, and were placed two to a car. They average about 35 h.p. each, and are geared to run the cars at a speed of about 25 miles an hour. The motors have done excellent service. Twice since the opening of the line for operation, the company have been obliged to increase the number of cars and motors.

The car bodies were built principally by the Ottawa Car Company, of Ottawa, and the managers believe that in construction and finish they are unsurpassed by any electric cars in Canada. The number of cars now consists of four large open cars, 45 or 50 feet in length, and with a capacity of 150 to 200 people to the car; five shorter cars, and four closed cars, in addition to the locomotive. Several of these cars have been added quite recently, as the traffic during last season was so great as to frequently compel passengers to satisfy themselves wih standing room only. It is with a view of doing away with this inconvenience to their patrons that the company has lately increased its rolling stock. During the year past, which was the first year of opening, the company handled over 300,000 people, and it is anticipated that during the present year this number will be doubled.

The operating expenses of the road were only 62 per cent. of the gross receipts, notwithstanding the fact that much experience had to be learned, and that last season was unprecedently wet and cold. During the summer months the cars ran every ten minutes, and throughout the winter an hourly service was maintained. The operations of the company so far have given

The Old Horse Ferry.

such satisfaction to the public, as to support the belief among some railroad officials, at least, that it is best to conciliate and please the patrons of the road. Incredible as it may seem to outsiders, before this railway was opened, the lower part of the Island was in a worse position as regards postal facilities and

traveling accommodations for the public than many country districts a hundred miles away. The only means of communication was the old-fashioned stage coach, which ran daily between Montreal and Bout de l'Ile, plodding its weary way through mud or snow drifts, as the case might be, exposing its patrons to a drenching rain or a burning sun, and consuming from three to six hours in making the trip. The evening newspapers' issues to-day did not reach their subscribers until to-morrow night, notwithstanding that these seekers after knowledge were within twelve miles of the metropolis of the country. The communication with Charlemagne and the towns along the line, some of them of very considerable importance, including the large town of l'Assomption, at which there is one of the most noted educational institutions in the country, was restricted until lately to a peculiar construction called the "horse-boat." This craft was composed of two hulls placed side by side, and planked over, a stern wheel is slowly revolved by means of a pair of unhappy-looking horses working a tread-mill. The approach of the boat to either side was irregular, and usually depended upon the impulse of the officials in charge. There was not, however, usually any chance of the waiting traveler losing his boat, as its approach was heralded from afar by the clanging and rumbling of the iron cogs of the wheel connecting the tread-mill with the unhappy horses at the back. In stormy or windy weather the boat usually declined to make any trip at all. One of those quaint craft is still to be seen at Bout de l'Ile. It is probably the most primitive form of ferry-boat to be found on this continent. J. H. Bernard, of Montreal, informed a representative of THE CANADIAN ENGINEER that his grandfather used to cross the St. Lawrence by this ferry over 100 years ago, and it was doubtless in use long before his day.

Some time, no doubt, the railway will be extended across the river. Sixty years ago an enterprising farmer on the other side of the river constructed a bridge at this point over both channels of the Riviere des Prairies, aggregating about half a mile or more in length. The model of this old structure is still to be seen in the old dwelling-house of the time. It is an ingenious construction, and bespeaks a great degree of industry and no little ability in the maker. This useful structure, however (for during its life it was used by a great many people), was not long for this world. Some three years after its construction the high water of the spring and the ice carried it mercilessly away, and nothing remains to tell the tale beyond the approach on each side, and here and there the ruins of a sunken pier.

Since the opening of the railway the aspect of everything has been changed. The beautiful farm sites along the banks of the river have been laid out in building lots, and many cottages have been erected. Four rivers, known as the l'Assomption River, Back River, and Riviere des Prairies, the two latter being branches of the Ottawa, and the mighty St. Lawrence, all come together at Bout de l'Ile, hence this point has been fittingly named "Where the Waters Meet."

ROBERT WELSFORD, ENGINEER.

The Belt Line cars are always on time at the intersection of La Salle street and Notre Dame street, in Maisonneuve. One of the strict rules of the company is that the cars run absolutely on time. The point of starting is reached by the Notre Dame street line of the Montreal Street Railway. During the winter the Ontario street line of the latter company has been extended to the intersection of the Belt Line, and during the coming season Montrealers will doubtless find it both pleasanter and easier to reach the Belt Line cars without the trouble of making any transfer on the way. By this means a passenger can take the Montreal street car at Wellington street, and for four cents enjoy a trip of nearly seven miles in length, where he again proceeds another twelve miles to a charming park at the end of the island, and which is so large that even when four or five thousand people are scattered over it, there can be found a quiet retired corner for himself and his picnic surroundings.

The officials of the company are W. Dale Harris, late managing director of the Ottawa and Gatineau Railway Company; John P. Mullarkey, managing director, a railway man of considerable experience; John Rowley, superintendent; Robert Welsford, engineer in charge of engines and plant, and C. H. Wright, electrician.

Robert Welsford, engineer of the Montreal Island Belt Line

W. DALE HARRIS, PRESIDENT.

Railway, was born in Paisley, Ont., 35 years ago. As a boy he obtained his education under great difficulties, having been able to go to school only two years, but while serving his apprenticeship as a miller, he studied at night, and made good headway in his studies. He filled good situations as miller with such firms as A. W. Ogilvie & Co., Montreal; James Goldie, Guelph, and Robert Noble, of Norval. Owing to fail-

J. P. MULLARKEY, GEN. MANAGER.

ing health, he quitted the milling business, and afterwards, having a taste for engineering, he took instructions in mechanical and electrical work for one week, and with this short appren-

tieship he installed the first arc light plant in Mount Forest, ten years ago. Since then he has been steadily employed as an engineer. Mr. Welsford's aim is to produce horse-power with as little fuel and friction as possible, and in aiming at this he has never been in want of a situation, while at the same time he has been able to help more than one fellow engineer in time of need. Mr. Welsford is the inventor of a new oil filter and waste sewer, which has been in use for five months at the Montreal Island Belt Line power house, with the most satisfactory results. We hope to give a description of this device in an early issue.

W. D. Harris, president, and J. P. Mullarkey, managing director of the Montreal Island Belt Line Railway, were associated on the directorate of Pontiac and Pacific Junction and the Ottawa and Gatineau Railways. Mr. Mullarkey was first connected with the Belt Line Railway as managing director, which position he held for about a year, when he purchased the capital stock, reorganized the company, and induced Mr. Harris to become president.

JOHN ROWLEY, SUPERINTENDENT.

John Rowley, superintendent of the Montreal Island Belt Line Railway, is an old steam railroader, having been connected with the Midland Railway, Quebec Central, Quebec & Lake St. John Railway, Ottawa & Gatineau Valley, Pontiac & Pacific Junction Railway. He also put in the large new main water pipe from Lorette to Quebec city, eight miles, for the supply of water to the city, bridging the St. Charles with a tubular bridge. The stop gates and all connections to that system were done under his supervision. He took charge of construction on June 1st, 1896, of the Montreal Island Belt Line, and charge of the operating department Nov. 1st, same year. Born in the city of Quebec, 1861, went through the common school and took commercial course through the High school, Quebec, under the noted principal, Daniel Wilkie.

C. H. WRIGHT, ELECTRICIAN.

C. H. Wright, the Montreal Belt Line Company's electrician, started with the Renfrew Electric Company as trimmer and cleaner. He then engaged with the old Royal Electric Co., of Montreal, as dynamo tender in the alternating and power station, and later as wireman. He subsequently joined the Edison General on installation work. Returning to Renfrew, he installed and operated a three-wire alternating plant, it being the first of the kind in Canada. Leaving there, he worked at Peterborough for the Canadian General Co., then for the Kingston Street Railway, and finally constructed the Belleville Street Railway line. In 1892 Mr. Wright entered McGill University, from which he was graduated as B.A. Sc. in 1896, taking honors and leading in all electrical subjects of the third year. In the fourth year he led the electrical engineering graduating class, taking honors in four subjects, and making all the marks obtainable in electrical laboratory work under Prof. Callendar. Mr. Wright was vice-president of his class. He entered the employ of the Belt Line when the first rail was laid, and when operation started he was taken into the permanent staff as electrician.

ACETYLENE GAS ON A CANADIAN RAILWAY.

The Pontiac Pacific Junction Railway Co. claim the credit of having the first express train in America, if not in the world, illuminated with acetylene gas. In conversation with Andrew Holland, of Ottawa, Wm. Ressman, superintendent of the road, suggested that acetylene gas would be a splendid illuminant for railway trains, if it could be safely handled. Mr. Holland expressed his firm conviction that it could be done with a Niagara Falls generator, if space in the baggage car were devoted to the purpose. Mr. Ressman at once placed two cars at Mr. Holland's disposal for the experiment. A twenty-light generator was installed in the baggage car. The cars were regularly piped for gas, with ordinary goose-neck drop fixtures. At each end of the cars the main pipe, ⅜, terminated with a hose cock, by which means the gas was piped between cars by rubber tubing. It was a hard time of the year for such a test, coming on the severe frost and storms of January. It was, however, a splendid success, so far as illumination was concerned. The light was as steady as starlight, bright and soft, so that passengers on the train could read the evening papers from any seat in the car with ease. The frost had no effect on the gas, and no amount of shunting could put out the lights. The disadvantages were: 1st, space occupied by the generator: 2nd, slopping over of the gas tank; 3rd, danger of causing slop and smell, should an explosion take place, where such a quantity of gas had to be generated, and trainmen with lanterns, pipes and matches always present; 4th, the putting out of the lights in the other cars when the baggage car had to be disconnected.

Mr. Ressman said if these difficulties could be overcome, acetylene gas, as an illuminant, had come to stay. It was cheap and effective. An idea suggested itself to Mr. Holland, that if small generators were coupled up in series to a main feed pipe, individual car lightning could be effected without any of the drawbacks complained of. The piping of the first-class car was slightly changed, five small generators, each 18 inches high, and 10 wide, were installed on shelves in a locker in the water closet. Mr. Holland felt confident that he had solved the problem. The first trip was a disheartening failure. When the train got up speed and the car began to rise and fall on its springs, out go the lights, and it took a box of matches to keep them re-lit. By the next trip, Mr. Holland had thought out a simple plan to remedy this defect, and the cars are now running with the lights in perfect order. Mr. Ressman has, in consequence, decided to equip both systems of railway, over which he has the management, with acetylene gas fixtures.

Mr. Holland's next experiment was with a locomotive headlight. The management of the Canada Atlantic Railway, ever alive to the improvement of their line, and the comfort, convenience, and safety of their patrons, placed a shunter engine at his disposal. The experiment proved the possibilities of acetylene gas as a headlight illuminant. Locomotive No. 26, of the Montreal express, was then temporarily piped ; for the headlight and gauge lamp, the postal baggage and express car were fitted up, and on Monday evening the express pulled out with the new light. Mr. Holland rode with the engineer, feeling anxious about the result, as the installation had to be put in so rapidly. The headlight was splendid, lighting up the entire right-of-way and far away ahead of the train. The terrific vibration of the locomotive did not affect it, but coming round a curve, a sharp rush of wind down the lantern ventilator extinguished the headlight, while the gauge lamp light, unprotected, was also blown out. The train was slowed down while the fireman went forward, re-lighted the jet, stopped the hole in the lantern with cotton waste, and the train proceeded without any further trouble. The postal car was so brilliantly illuminated that the clerks told Mr. Holland he would have to come with a revolver in both hands to take out his plant again. It is claimed that the system adopted by Mr. Holland is at present the only safe

way known to utilize acetylene gas where the generator is subject to vibration and is liable to come in contact with fire by accident or design. He deliberately explodes a generator without doing any more damage than causing a report like that of a toy pistol. The safety lies in the fact that only a very small quantity of gas is generated at one time. Railway men are taking a deep interest in the new light. Mr. Bailey, of the Railroad *Gazette*, of New York, came to Ottawa specially to investigate the system, and after seeing the generator charged and the train lighted, declared it to be the most simple and effective light for railways that he had ever investigated. The Government car "Cumberland" has been piped for gas and a plant installed. Mr. Schreiber is anxious to have the gas system thoroughly tested as to safety, as well as efficiency. It will be of interest to railway engineers to know that the locomotive headlight generator makes the run from Ottawa to Montreal on two pounds of carbide, costing three cents per lb. wholesale.

THE YORK STREET BRIDGE, TORONTO.*

This bridge is at the foot of York street, Toronto, and gives access to the water front from the city for vehicles and pedestrians over the numerous railway tracks at that point As the bridge was built jointly by the city and the Canadian Pacific Railway, the plans were prepared by P. A. Peterson, chief engineer of the C.P.R. and approved by the City Engineer of Toronto.

The general design of the bridge is a steel trestle, composed of about 32 spans deck plate girder, ranging from 30 feet to 70 feet span, with wooden stringers and decks. There are also in addition two spans of less than 20 feet, rolled steel I beams. These girders and I beams rest on iron columns, standing on stone pedestals, except at the three ends of the bridge, where there are stone abutments. The width of the roadway, except on the southerly ramps, is 37 feet 6 inches, with sidewalks on each side 7 ft. 6 in. wide. On the southerly ramps the width of roadway is 32 feet 6 inches, with one 7 ft. 6 in. sidewalk. The ground plan of the bridge is "T-shaped," with the base resting on the south side of Front street, and it extends southerly therefrom, across the deviation of York street and the railway tracks to Lake street, a distance of about 906 feet. Here the ramps of the bridge turn, one to the right, and the other to the left, and descend to the level of the street. The length of these ramps is each about 316 feet, making a total length of bridge of 1,538 feet. From Front street the roadway of the bridge rises with a grade of one foot in twenty, for about 298 feet, and at the Lake street ends, there are similar falling grades of one in twenty, about 500 feet in length. Heavy loads to the railway freight sheds are taken over these grades every day, and no special difficulty seems to be experienced. There are in all three abutments and sixty-eight pedestal blocks. The foundations of the two Lake street abutments and all the pedestal blocks, except fourteen north of the south line of the old Esplanade, are on piles driven to the ledge rock. This was necessary, as this land was formerly part of Toronto harbor, and had only been filled in the year previously with miscellaneous rubbish, earth, brickbats, tin cans, as well as more objectionable refuse. When piles were to be driven, an excavation was carried down to one foot below zero level of the water of Toronto harbor, and soundings were then taken down to the rock. The piles were then cut off the correct length and driven home, with a "follower." Under the specifications, the piles were to be cut off one foot below zero level, and the above method was found less expensive than actually cutting them under water, and it was very seldom that a pile had to be cut when once driven home. Only a very blunt point was made on the pile, before driving. Four piles were driven for the small pedestals, eight for the medium and nine for the large pedestals. Under the abutments the piles were 4 ft. centres longitudinally, and 2 ft. 6 in. transversely. The excavation was then carried down six inches below the top of the pile and two feet in depth of concrete put in. In some cases where the underlying material was very soft, short lengths of two-inch plank were laid flat under the concrete, between the piles, in order to keep the concrete from settling on the soft material before it was set. The concrete foundation is 7 feet square under ten of the pedestals carrying the longer spans, 6 feet square under nine of the pedestals, 5 ft. 6 in. square under five pedestals, and 4 ft. 6 in. square under the remaining 44, and is generally two feet deep. The concrete was composed as follows, except when laid under water: Cement, 1 part, clean sharp sand, 3 parts, broken stone, 5 parts—all by measure. Under water the concrete was composed: Cement, 1 part, sand, 2 parts, broken stone, 5 parts. The cement used was the "Star" brand, made by the Rathbun Company, of Deseronto. Below ground the stonework is what is known as "rubble masonry:" above ground it is "rock-faced ashlar," and was built under the Canadian Pacific standard masonry specifications. The stone was brought partly from the contractor's quarries at Owen Sound, and partly from the Orangeville quarry. The contractor for concrete and masonry work was David Chalmers, of Owen Sound. The piling was done by the railway company's own men, and their track pile driver. The two top courses of the pedestals had to be drilled before being placed in position to receive the 1¼-inch iron rods which secured the iron columns to the masonry, and some little difficulty was experienced drilling completely through these stones without breaking them. This drilling was done with a steam drill, half from each side of the stone. The iron work was erected during the winter of 1896-7. It was supplied and erected by the Central Bridge and Engineering Co., of Peterboro', Ontario, and was paid for at so much per lb. in the finished work. The bridge was designed to carry in addition to its own weight the following live loads, either singly or in any combination: (a) 100 lbs. per sq. feet of roadway and sidewalk, (b) one 32,000 lb. road roller having a wheel base of 11 ft. 2 in. in length and 7 ft. 4 in. transversely, (c) a string of electric cars 26 ft. long, each weighing 30,000 lbs., fully loaded, on each track.

All parts of the structure were proportioned so that maximum loads should produce no greater tensile strain upon the net section than 12,000 lbs. per sq. inch. A wind strain of 400 lbs. for each longitudinal lineal foot, and 150 lbs. for each vertical lineal foot of the trestle bents was allowed for.

All steel had to come up to the following requirements:

Ultimate strength	58,000 to 65,000 lbs.
Elastic limit	33,000 lbs.
Elongation in 8 inches	20 p.c.
Reduction of area	40 p.c.

and was made by the open hearth process. Before leaving the shop it was thoroughly cleaned of all loose scales and rust with steel scrapers and brushes, and was then given a good coating of red lead mixed with linseed oil, well worked into all joints and surfaces, and after erection the ironwork was given two more coats of paint. All the timber in the deck of the bridge, with the exception of the sidewalk planks and paving blocks, is southern yellow pine, creosoted with 10 lbs. of dead oil of coal tar per cubic foot.

On top of the joists and 4-inch plank, were laid two thicknesses of best tarred paper, thoroughly sealed with roofing pitch to the planking, and each other. On top of this was laid the paving blocks, consisting of square-cut white pine blocks, 8 in. x 4 in. x 4½ in. deep, grain upwards. These blocks were held apart at the cross-joints by three specially-made nails driven into each block up to the collar, leaving the blocks 3-16 in. apart. All joints and vacancies were then filled in with best paving pitch, and the roadway covered ½ inch deep with gravel. A double track girder rail for electric cars was laid across the bridge by the Street Railway Company before the paving was done, for possible use in the future. The sidewalk planks are of tamarack, 7 ft. 6 in. long, 2 in. thick, laid with 1½-in. felt towards the kerb. The cost of the structure was approximately:

Foundation and earthwork (including piling)	$ 4,200 00
Stone and concrete work	15,900 00
Ironwork	43,000 00
Damages St. James' hotel property	4,900 00
Deck and roadways	28,000 00
Engineering	2,000 00
	$98,000 00

* Extracted from a paper read before the Ontario Land Surveyors, by A. P. Walker, of the City Engineers Staff, Toronto.

ONTARIO LAND SURVEYORS.

The adjourned annual meeting of the Ontario Land Surveyors was held March the 8th in the repository of the association, in the Parliament Buildings, Toronto, the president, T. H. Jones, of Brantford, being in the chair. On this, and the two succeeding days, the meeting was occupied in hearing the reports of the various committees, and in listening to the reading of a number of very valuable papers by different members.

Extracts from some of these papers will be given our readers next month, as lack of space prevents us giving a full report of the meeting in this issue. The annual dinner took place on the evening of the 9th, and was a most enjoyable affair, being more largely attended than any previous dinner. The nominations of officers resulted as follows: President, P. S Gibson, elected by acclamation; Vice-President, H. J. Bowman, elected by acclamation; Secretary-Treasurer, A. J. Van Nostrand, elected by acclamation. For Council of Management, in place of F. L. Foster and J. L. Morris, whose terms expired 1st of April, four candidates, F. L. Foster, J. L. Morris, Geo. Ross and Capt. W. F. Van Buskirk, were nominated. For auditors, A. W. Campbell and H. L. Esten, by acclamation. The president appointed as scrutineers of ballots Capt. K. Gamble and J. F. Whitson, who will, on the 7th of April attend the opening of the ballots by the secretary.

STEEL CYLINDER PIERS.

Editor CANADIAN ENGINEER :

In the item in last issue of THE CANADIAN ENGINEER *re* bridge recently completed at Dundas, Ont., you say it is supported by steel "rail" piers. This should be steel "cylinder" piers. This is a small error, but I would not like anyone to think I would construct a pier of steel rails.

Yours very truly,

JNO. S. FIELDING, C.E.

Hamilton, March 12, 1898.

MINING IN QUEBEC.*

BY J. OBALSKI, G.M E

The state of the mining industry in the Province of Quebec during 1897, is shown by the following notes, and is quite satisfactory, although there is no booming, for the present, on any of our minerals. I would mention copper and asbestos mining, charcoal iron-making as very important industries, with mica and chrome coming after, besides a few others which may become prominent later on.

IRON.

The Radnor forges had its furnace in operation for the whole year, and the Drummondville, one since July. They have produced 8,386 gross tons of pig iron, 680 men being employed by this industry. The consumption of raw material has been 19,766 gross tons of bog ore, 2,545 gross tons of limestone, 1,031,800 bushels of charcoal. The quality of the product need not be mentioned. It is a credit to our country: in fact, it is highly praised, not only in Canada, but in the United States and Europe, competing with the best brands on either of the continents.

CHROME.

This year, shipment has been 2,340 gross tons, mainly to the United States, and we have still in hand over 2,000 tons, about 60 men being employed. Our ore is mostly high grade, but I consider that with concentrating plants, we could use our low grade ore and the refuse of the mines, and considerably increase our shipments. This industry is in its infancy, but nevertheless, with only hand-working, we have taken out, since 1894, over 10,000 tons, representing an approximate value of $140,000, of which 8,183 have been shipped. I refer to a pamphlet I am just publishing on the subject.

TITANIC IRON.

I would make mention of the discovery of important deposits in the Lake St. John district. People have also an eye on our magnetic sand, on the north shore, which may eventually become profitable to handle.

OCHRE

Is prepared as in the past by two companies, in the vicinity of Three Rivers, with a production of 1,239 short tons of burnt ochre, which have been used in Canada, or shipped to the United States, 50 men being employed.

COPPER.

Our low grade ores have been worked as usual, at Capelton, the product being 36,815 gross tons, of which 29,512 tons were shipped to the United States, a small cargo to England, and the balance used on the spot for sulphuric acid manufacturing, 270 men being employed. At Harvey Hill, some work has been done, but only 20 tons of high grade ore shipped. Several prospects have been made at a few points of the Eastern Townships, and the time may come when this industry will be one of the most important of this province, if we take into consideration the numerous good mines actually idle

LEAD, ZINC AND SILVER

On the Calumet Island several good prospects have been made, showing the existence of an important mineral belt, containing zinc blend, and rich galena, carrying sometimes 200 ounces of silver to the ton. The Lake Temiscaming mine has also been worked to some extent, but no shipments made, and we may say that last year's output has been 450 tons of zinc blend, and 5,000 tons of galena, 45 men being employed

GOLD.

Prospecting was going on in the Beauce district, on the Gilbert, on the du Loup, and in Dudswell district, with also some finds reported in the vicinity of Sherbrooke Besides those we know of, every summer, small parties find their living by washing in the rivers of our gold district Some preparatory work has been done last fall on the old diggings of the Gilbert River, and according to recent informations, gold, in paying quantity, has been struck. I estimate approximately, that not more than $900 of gold have been taken out during the year. The question of the Beauce district has been discussed at length at previous meetings, and although not yet satisfactorily settled I personally am fully confident in the final success of that region.

GRAPHITE.

The graphite industry is one of the most difficult to operate advantageously in Canada, as we have to compete with old establishments in the United States, taking easily their supply from Ceylon. In the Buckingham district we have three companies with well equipped mills, two using the wet, and one the dry process, and it appears to me that their product is as good as any other one, and all that we require is a regular market for it. But little work was done last year, and we have not the account of the production.

ASBESTOS.

The market for asbestos has been fair: three companies at Thetford, and one at Danville, employing altogether 800 men, have been in operation for the whole year, having shipped 12,565 tons of 2,000 lbs., of fiber, about 42,000 gross tons of the new product, called asbestic, have also been prepared, of which a very large quantity has been shipped, and the contracts made for the coming year will, it is expected by the company, take the entire output. Shipments have been made to England, Germany, Australia, South Africa, besides the United States and Canada. The Black Lake mines have not been in operation this year, and the production of two companies, having their mill in the Laurentian district, near Ottawa, was small, little work being done.

PHOSPHATE.

No work done on this material, except a few hundred tons extracted from the mica mines.

MICA.

Several prospects were made in the Gatineau district, but of small importance. In the vicinity of Perkins mill, in Templeton, three important companies have worked regularly, and taken out a large quantity of mica, well adapted for electrical purposes, of which a good part has been sold in Canada, and in the United States. It is very difficult to give exact figures regarding this mineral, on account of the numerous qualities and sizes, representing as many different prices, but according to the best informations, I estimate that about 200 short tons of thumb-trimmed mica have been taken out, 90 men being employed. I understand that the demand is less than previously, on account of the high duty in the United States, and that only the best grade of electrical mica is wanted. No mine of white mica has been worked last summer.

PETROLEUM.

Prospecting and boring are going on as usual in the vicinity of Gaspe. Last season, some excitement prevailed on account of a larger quantity of oil being struck in one of the wells, which, in fact, has been flowing for some time. Nevertheless, nothing very definite has yet been ascertained. About 30 wells have been bored, some of them having struck oil in greater or less quantity. I am confident in the future of this district as an oil-bearing one, but the country is large, and its stratigraphi-

*A Paper read before the Federated Canadian Mining Institute.

cal structure not very well known. We don't know that any shipment of oil has been made, so far, except some barrels as specimens, and. in fact, there is not yet regular pumping done.

FELDSPAR.

In the vicinity of East Templeton Station, a quarry of feldspar has been worked with 15 men, for the whole season, the quantity shipped being 1,260 short tons. The material appears to be of a good quality, and is sent to the United States for ceramic purposes. A few other deposits of them, connected with white mica mines, exist, but are not worked.

KAOLIN.

I want to make a special mention of the discovery of this material in our province. In 1894 I visited the township of Amherst, Labelle county, and my attention was called to a white material, which, after testing, I was able to pronounce to be a genuine kaolin. The indication was a small one, but may lead to the discovery of an extensive field of said material. Subsequently R. Lanigan, from Calumet, secured some property there, made some prospects, and came to the conclusion that workable deposits existed. He also sent specimens to porcelain works, and received high testimony regarding the quality. The Imperial Porcelain works, of Trenton, U.S., have pronounced it of a superior quality. The district above-mentioned is five miles from the Montfort Railroad, which connects with the C.P.R.

MOLYBDENITE.

We have enquiries from a party in England about this mineral, which I understand has some new use in a form of alloys, but the price offered (14 cents per lb.), does not give much chance for the opening of our small deposits, which, besides not being developed, are rather far from ordinary communication, we know of only three deposits giving indications of some importance, one on the north shore of the St. Lawrence, and the other in the Gatineau valley. The latter was discovered in Egan township, about 110 miles from Ottawa; the surface indications would justify further development.

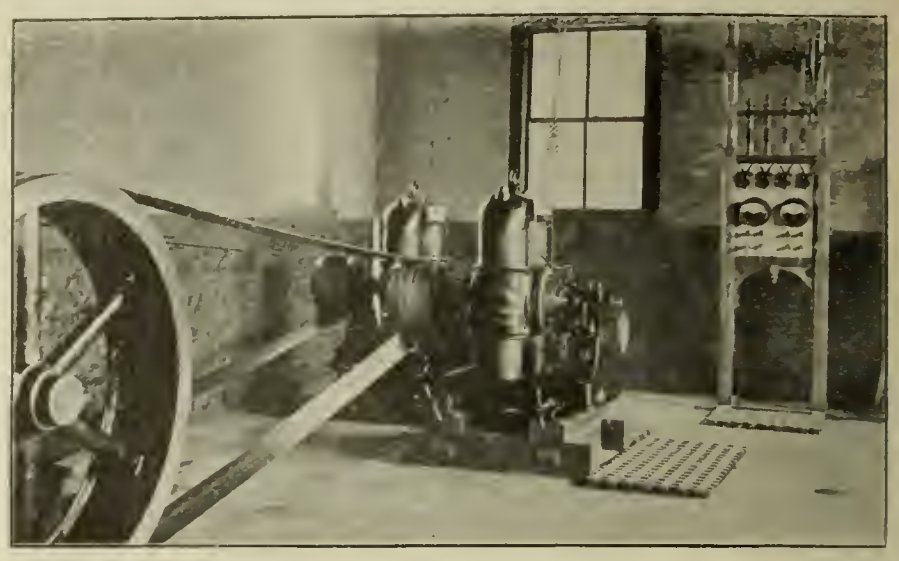
BUILDING MATERIAL.

There is nothing special to mention in this line. We have shipped 3,208 tons of 2,000 lbs. of slate, 90 men being employed, and also 1,072 tons of flag-stones. I am not prepared to give any figure on the building stones, notwithstanding its importance. Re granite, the Stanstead, Whitton and Lake St. John quarries have been in operation, as usual, the latter only for local supply. The limestone quarries, on the Trenton belt, between Quebec and Ottawa, have been extensively worked. We record, for 1897, a production of 14,000 barrels of cement, but new companies are in process of formation, and preparations are made to considerably increase it for the coming year. If we consider the large consumption of such material, in our country, which is partly supplied by an importation of over 200,000 barrels, we may look for a good future for this industry. The established lime kilns and brick-yards are going on as usual. It is not easy to give exact figures regarding the same, as they are scattered all through the province, but by careful researches, I am able to give the following: Approximately, we have, in round numbers, 300 lime kilns, producing one million of bushels of lime, of a value of $140,000, with 250 men employed all the year round. In round numbers also, we count 150 brick-yards, employing 1,200 men for the summer season, and producing 120 millions of bricks, of a value of $600,000.

As a conclusion, I may say that the raw value at the mine of the minerals taken out from this province, represents about $1,800,000, including the building material, the number of men employed the most part of the year being about 4,000.

CHATHAM MUNICIPAL PLANT.

The electrical equipment of the municipal arc lighting plant installed by the city of Chatham, Ont., last fall, consists of two automatic arc dynamos of nominally 50 lamps capacity each. These are supplying current to 104 arc lamps and 10 series incandescents, through circuits which aggregate some 24 miles in length. The 10 incandescent lamps and two arc lamps are used for illuminating the power-house and adjoining waterworks plant, while 102 lamps are for street illumination exclusively. These latter are provided with substantial telescoping storm protectors, and are suspended from a suitable steel mast arm. Sleet-proof lamp supporting pulleys and thoroughly insulated lamp hangers are used throughout. The outside circuit is of No. 6 B. & S. hard drawn copper wire, triple braided, strung over double petticoat insulators, and at intervals of two



POWER HOUSE—CHATHAM MUNICIPAL PLANT.

miles is protected by an effective magnetic blow-out lightning arrester. Wherever possible, the circuit is divided into loops, comprising some five to ten lamps, each loop being controlled from a substantial absolute cut-off switch.

The interior wiring is of No. 6 B. & S. rubber-covered wire. A plug switch-board, arranged so that machines and circuits may be interconnected, is provided. This is furnished with ammeters and magnetic blow-out lightning arresters of a new pattern, the whole being neatly arranged on a white marble base. The whole plant was subjected to the most vigorous tests which would ever meet the demands of service. The machines were short circuited at full load for one minute, and also while at full load the circuits were suddenly opened. These tests thoroughly demonstrated their ability to withstand any exigencies of service. This was manufactured and installed by the Thompson Electric Company, then of Hamilton, but now amalgamated with the Toronto Electric Motor Co., and doing business in Toronto.

REPAIRS IN DOCK.

Editor THE CANADIAN ENGINEER.

SIR,—I recently ran across what I considered a rather smart piece of work. I was down at the wharf of the American Line in New York city, and noticed lying on the wharf a propeller blade, the tip of which had about two feet knocked off. I made inquiry, and discovered that it had been taken from the starboard propeller of the steamer "New York," which vessel was then alongside the wharf, being in the course of preparation for sea. It transpired that the job of removing this blade commenced just about 24 hours previous to the time at which I saw the men removing the gear and tackle used in dry-docking the propeller, as she was in wet dock. The work was commenced one morning at 10 a.m., the nuts slacked back, of which there were eight, perhaps 3½-inch diameter, the old blade removed, new one substituted, inside the period of about 24 hours. One can readily see what a saving is effected by being able to so make it possible to work in this way at a damaged propeller, and at the same time allow the cargo to be worked. I judge the weight of the propeller blade to have been about four tons. I have spent a night even in a dry dock slacking back nuts on jobs of this kind, and I consider this piece of work on the "New York" quite an example of ingenuity.

Yours sincerely,

JAMES J. SALMOND,
Box 388, Port Richmond, N. Y.

THE VENTILATION OF PLUMBING APPLIANCES.

We have received a letter from a writer signing himself "Plumber," in which he requests us to ask our sanitary correspondent to give our readers his views on the advantages and disadvantages of the present method of ventilating plumbing appliances and waste pipes, traps, etc. We have submitted the letter to our regular correspondent, W. M. Watson, Toronto, and have received the following reply, to illustrate which the accompanying drawings have been made:

In answering this query, let me first say that if "Plumber" had studied the articles on sanitary matters published in almost every issue of this paper for the past one and one-half years, he would have been already pretty well informed, especially by studying the one in the issue of April, 1897. The first and most important rule in fixing sewer and house waste pipes, is to

arrange every part, if possible, equally graded, with a constant rise upwards, so that a continuous supply of air will regularly pass through every portion except the traps, avoiding any air pockets, where air may lodge motionless and putrefy. See illustration I. in page 351 of the April, 1897, number of THE CANADIAN ENGINEER, except the sink pipes, which by mistake were shown wrong. The method of fixing vent pipes at the highest point of the bend, or knee, of traps, is wrong (see Fig. 1) and in a short time frustrates the intention in so placing it,

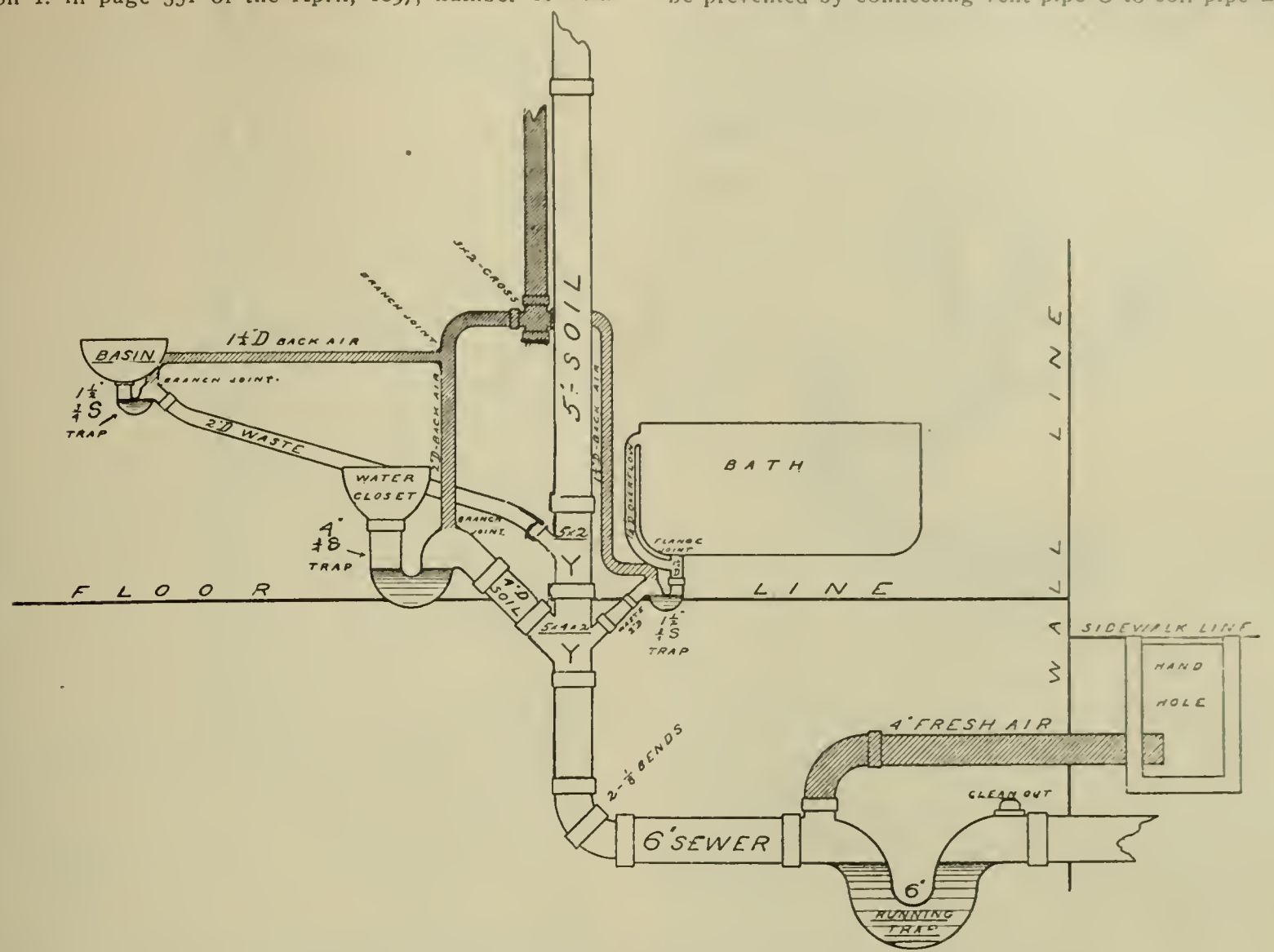


FIG. 1—PRESENT METHOD OF FITTING WITH BOTH PIPES THROUGH THE ROOF.

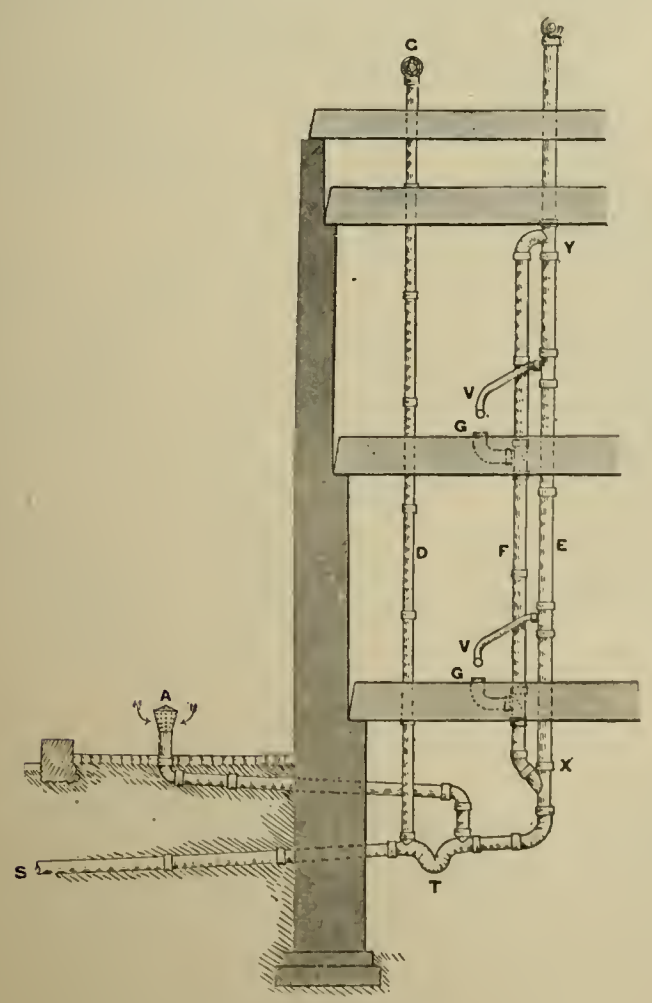
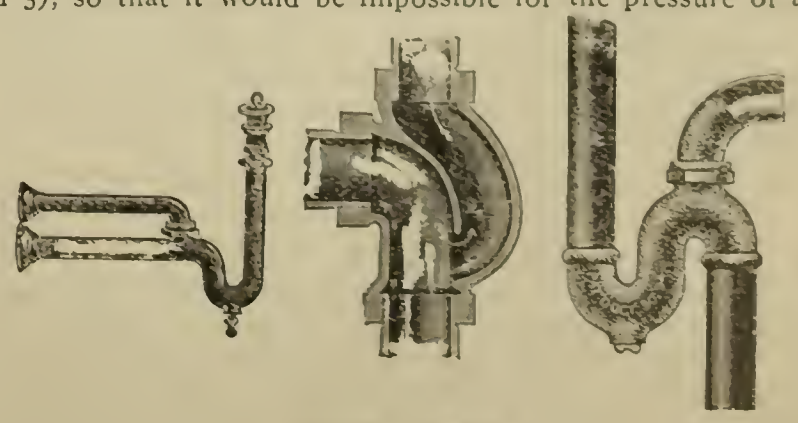


FIG. 2—SEWER VENT.

because each time that soapy water is forced round the sharp bends in the trap a froth is formed which flies up into the vent pipes and dries on like a coat of paint, gradually closing the opening until the pipe becomes useless. Moreover, wherever there is a separate stack for the use of ventilation alone (see Fig. 1), there is often a strong down-draught, varying momentarily, according to the pressure changes of the atmosphere at the terminating points, which causes an oscillation of the water seal in the most sensitive traps fixed on the line. That causes the seal to overflow, and break the key. This might partly be prevented by connecting vent pipe C to soil pipe B at junction, Fig. 2. Therefore, it is always safer to join the main ventilation pipe into the side of the soil pipe stack (see junction Y, Fig. 2), at a point before it passes outside, when in that case the down-draughts will act directly and squarely down the soil pipe to the main drain, or through the floor line breather pipe. The illustration in the April number will also explain this point still more. Then, vent pipes that are open to the outside air convey a drying atmosphere to the water seal, which quickly absorbs the moisture, drying out a 1½-inch trap very quickly, especially if the pipe is attached to a separate ventilation stack, or the vent is coupled in a way that the body of air presses squarely on the water seal contained in the trap (see Fig. 6 and Fig. 1), or there is hard, dry frost, or hot, drying air outside. They also often act as an overflow tank when the waste pipe is choked, because of the sewage forcing upwards into them when it can not freely flow downward by the proper pipe, gradually dribbling away down the waste pipe afterwards. They form obstructions, and often cause stoppages by small points of solder dropping in when wiping the joints, and also the roughness of the end of the vent pipe, peeping through at an intricate point where smoothness of turn is absolutely necessary. Therefore, if vent pipes are needed, they ought to be inserted a few inches backward from the crown of the bend (see Figs. 3, 4, and 5), so that it would be impossible for the pressure of the



FIGS. 4, 3 AND 6.

atmosphere to rest directly on the off-side of the water seal of any trap.

Plumbers may have noticed that the vents of English-made w.c.'s are never on the crown point, but act almost as a right

angle branch. They make it hard to remove a choke in a waste pipe that is vented, because a force pump is useless, the fluid passing up the vent when it ought to be making pressure in the waste pipe to force the obstruction.

The fad of the so-called trap syphoning is almost a canard. It can easily be done, but it does not occur naturally once in 100,000 times. There is a danger of the traps being drawn in places where soil pipes stop at the closets, and there is no vent of any kind through the roof, and the w.c. used is of the George Jinnings or Demarest kind, that drops about three gallons of

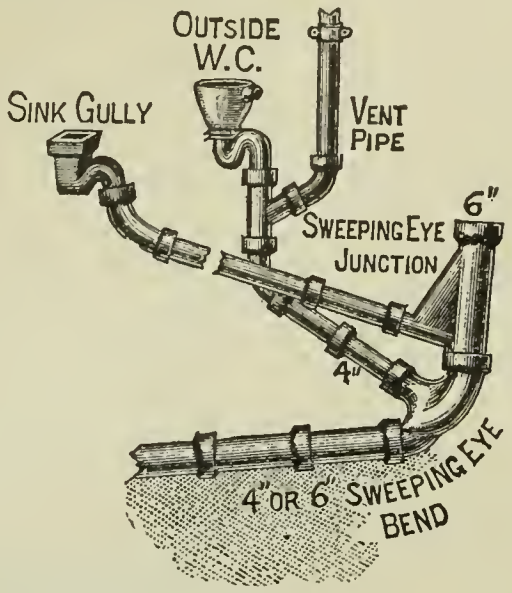


FIG. 5.

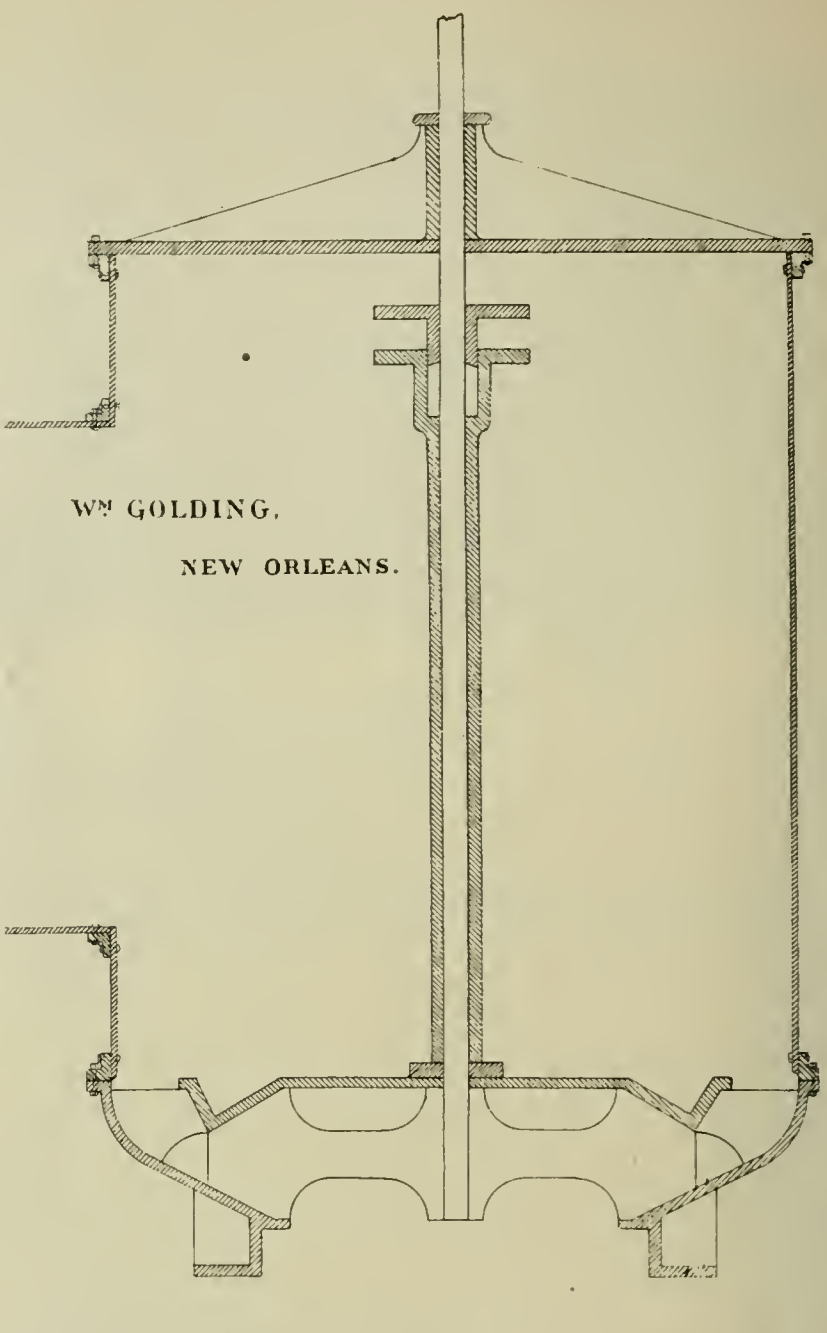
water and the excrements, etc., down the soil pipe suddenly, like a piston passing down a smooth cylinder, causing a considerable vacuum behind, because there is no vent pipe to bring in the atmosphere and fill the space, so it must needs draw it through the w.c. trap, and should it not have reached a larger pipe or sewer before the valve is dropped down again (of course backing the air from going that way), then the vacuum will draw any or all of the small traps in the house. But a water closet flushed by cistern and 1½-in. lead pipes can never syphon any traps, because the water and solids do not go down in bulk sufficiently large to fill a space of a 4-inch pipe, and the air will pass off in the opposite direction. Nor can syphoning ever occur where the soil pipe end is open above (see G. Fig. 2), and also sketch in last April number. The intricate fittings and methods of arranging pipes have caused more premature deaths than the well-appointed and carefully-constructed plumbing put in over thirty years ago, which was totally void of ventilation, but which also never had any dried-out water seals, which in Toronto are answerable for many deaths.

Three years since, I was privately engaged to go to a house having the best and latest designs and workmanship in plumbing throughout the place. I arrived in time to see some members of the family taken away by diphtheria, leaving only the nurse and another ill in the house. I proved enough to believe that it was the overdone plumbing and dried-out trap seals that hurt them, and if the eyes of those who understand air currents and sanitary matters were properly used, more such proofs of the danger of going to extremes in sanitary matters would be forthcoming.

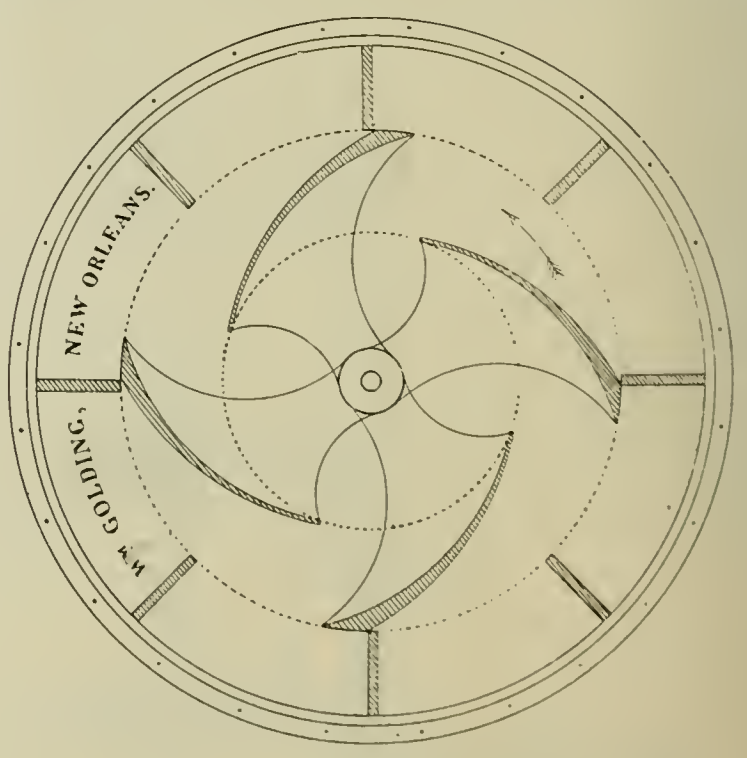
I have so far dealt with the evils of the present method of connecting ventilation pipes to waste pipes, and fixing them often where they are not needed, and where they do a real and positive harm, but the law requires them so to be placed, and though it was made probably by men void of practical knowledge and very ignorantly stupid in such matters, it must be carried out, if the whole town is injured thereby. In another article I will try to show the advantages the present method possesses.

CENTRIFUGAL PUMP.

The annexed sketches illustrate a type of centrifugal pump, the invention and design of Wm. Golding, C.E., New Orleans, La. The feature of this pump is the wheel cover, which rests in taper fit upon chucks, that are cast on the lower portion of the wheel box. There is no fastening to this cover, none being required, as the weight of the water will hold it down. Should the wheel break, or should any obstruction prevent its free movement, the cover and wheel may be removed from the case by simply taking away the upper spider. The lower part of



the discharge branch should be placed on a level with the minimum height of outfall receptacle, while the upper portion of discharge branch will be on a level with maximum height of outfall receptacle. The driving power will be attached to end of the wheel shaft above the spider. To ascertain the discharge



capacity of this pump, ascertain the cubic contents of wheel box (between dotted lines), and multiply by 4, for 4-bladed wheel, and by 5 for 5-bladed wheel, etc., etc., for each revolution of shaft, for the reason, as will be seen, that the wheel box is emptied four times per revolution. To ascertain the power required, ascertain the foot pounds in the quantity to be lifted, and add 50 per cent. The efficiency of this pump when properly installed is claimed to be 85 per cent of the power applied to the shaft.

MOVING TIME!! Subscribers are reminded to notify us of any change in address necessary. Give both old and new addresses.

THE PUBLISHERS.

EXTRACTS FROM ADDRESS OF GEO. E. DRUMMOND, PRESIDENT FEDERATED CANADIAN MINING TRUST.

Within the next few months Great Britain will pour into this, the first of her colonies, thousands of her sons and a vast amount of capital. The United States and other countries will contribute their quota in men and money, and Canada stands upon the threshold of a great national advance that means not only an early increase in material wealth, but what is equally important, that her natural resources shall at least be better understood and better valued both at home and abroad.

We who are directly interested in mining know that the Klondyke represents but a very small part of the great natural wealth of this country, and we are, therefore, confident that, properly directed, the workers and capitalists now coming to our shores, if by chance unsuccessful on their first adventures on the gold mines of Canada, can be absorbed to their own benefit and to that of the Dominion in many other fields of lucrative labor and investment which this country affords. The wealth of our coal fields and iron mines is undoubted. We are rich in silver, copper, asbestos, mica, plumbago, phosphate, chromic iron, galena, corundum, talc, and almost every mineral known to science.

Without presuming to dictate to our English and European friends, the members of this association may be permitted to express the opinion that the Canadian mining engineer, acquainted with this particular field of operation, experienced in the ores of this country, and fully understanding the climatic conditions under which the work has to be carried on, is better fitted to cope with and overcome natural difficulties than, for instance, an engineer who may have gained his experience on the free milling reefs of South Africa.

The official returns of the Geological Survey of Canada, just published, calculates the total production of minerals in Canada during the year 1897 at $28,789,173, an increase of $617,934 over the production of 1896. In 1886 the total production of minerals in Canada only reached a value of $10,000,000. What can better attest the importance of developing the mining industries of the Dominion than this advance of nearly 188 per cent in the short space of eleven years. . . .

In reviewing the different sections of mining, the address continued: The coal areas of the Dominion are estimated at 97,200 sq. miles, not including areas known, but as yet undeveloped in the far north. First the coal fields of Nova Scotia and New Brunswick; second, those of Manitoba and the North-West Teritories, and third, those of British Columbia.

The operations for 1897, so far as reported by the Bureau of Mines and the various companies interested show as follows:—

In Nova Scotia, coal raised	2,345,138 tons.
" New Brunswick, coal raised	6,000 "
" Manitoba and North-West Territories, coal raised	297,000 "
" British Columbia, Vancouver Island collieries, coal raised	798,458 "
	3,446,596 tons.

The production of coal for 1897 may be put down at a value of at least $7,000,000.

Coke—Nova Scotia reports the production in 1897 of 58,000 tons of coke.

We are without actual figures for the production in other sections, but it is gratifying to note that the coal companies of the Dominion are gradually extending their trade, export as well as native, through the medium of their coking plants.

Quoting from the Canadian Mining Manual of 1897: In 1884, 49 steamers, 18 sailing vessels, and two large barges were employed in the St. Lawrence-Maritime trade, when $360,680 were distributed for labor in transportation, trimming cargo, handling, etc., and $55,556 for wharfage, and $55,333 for pilotage. In all a total for these three items of $480,577.

Iron—During the earlier months of the year the Nova Scotian furnaces, as well as the one situated at Hamilton, Ont., were practically closed down, awaiting the decision of the Government regarding the tariff. That happily settled, the furnaces went to work (the Hamilton furnace as late as 29th June), with the result that at the close of the year the returns show an output of coke iron pretty well up to that of 1896 and an increased output of charcoal iron. Advices received from New Glasgow, N.S.; Londonderry, N.S.; Radnor Forges, Que., and Hamilton, Ont., report a combined gross production of about 57,904 net tons of pig iron, 18,562 net tons of steel, 1,403 net tons of forgings, 4,646 net tons of bar iron, puddled bar and other finished products, the three last mentioned items reported by the Londonderry Iron Co.

The capital invested, the number of men employed and the quantity of materials used remain practically about the same as in 1896. The output of charcoal iron at the Radnor Forges furnace, included in the above returns, shows an increase of 50 per cent. over the operations of 1896. The whole outlook in the Canadian blast furnace business is promising.

Our charcoal iron has taken front rank in point of quality, and so far as coke iron is concerned, Canadian founders now acknowledge the product for home furnaces to be equal in every way to the imported American article.

Ferro-Manganese—During the year the plant of the Pictou Charcoal Iron Company at Bridgeville, N.S., has been leased to the Mineral Products Company, who are undertaking the manufacture of ferro-manganese. The company has secured important concessions in manganese mines in Albert county, N.B. These operations will be watched with considerable interest by members of this Institute, who wish the new venture every success.

Chromic Iron—The returns for 1897 are not yet completed, but we are glad to be able to report shipments by the Quebec Central Railway to the extent of 2,593 tons. The quantity shipped in 1896 from the mines of the Province of Quebec, with points of destination, was as follows:

To Philadelphia	750 tons.
" Pittsburg	1,232 "
" Other points	55½ "

Mr. J. Obalski, Inspector of Mines, Que., estimated in his report for 1896 that during the preceding four years 10,500 tons of chromic iron had been raised, of which quantity 9,000 tons was shipped from the Province of Quebec. A concentrating plant is badly wanted to raise the values of a very large quantity of this mineral in the Eastern Townships, at present too low to market at a profit.

Mica—Quebec Province reports the total production to a valuation of $125,000, and we are also glad to report English capital recently invested in Ottawa County mines.

Phosphate—Some phosphate has been taken out during the past year in working for mica, and enquiries for this mineral are more numerous, although the prices offered are as yet too low to admit of actual business.

Gold.—Of all our mineral wealth, gold has excited far the greatest interest. . . . . The total production in Canada in 1897 is reported by the Geological Survey of Canada as $6,190,000.

The President then reviewed the conditions in the Yukon, British Columbia, Nova Scotia, Quebec, Ontario, and concluded: A matter of note is that important indications of gold-bearing quartz are found in the Sudbury district at Lakes Wahnapitae and Temogaming. This district, already famed for its deposits of nickel ore, is said to be very promising in gold.

Silver.—The total output for 1897 was 5,558,446 ozs., valued at $3,322 905.

These minerals continue to be the principal source of dividends in British Columbia, substantial profits having been realized by the Slocan Companies, among others the Payne, Whitewater, Peco, and the Hall Mines, Ltd. The figures for the past year are not yet reported, but they show an increase upon those of 1896.

In Ontario, a number of mines in the neighborhood of Port Arthur have been re-opened.

In Quebec important operations were begun, and shipments made from Calumet Island, Ottawa County. A valuable deposit of argentiferous galena has also been discovered in Brome County, on the shores of Lake Memphremagog, which is now being investigated.

Lead.—The total production in 1897 amounted to 39,018,219 ozs., a value of $1,396,853.

Asbestos.—The Geological Survey report gives the output of asbestos and asbestic as 25,262 tons, valued at $324,700. The shipments reported by the Quebec Central Railway for 1897 show:

Black Lake	1,020,425 lbs.
Thetford Mines	16,110,135 "
	17,130,560 "

It is pleasing to note the considerable trade that has sprung up for the refuse sand and short fibered asbestos for use as fireproof plaster, for which purpose it is admirably suited.

Copper—The copper ore mined in the Province of Quebec during 1897—39,928 net tons. Of this quantity 31,080 net tons went to the United States, the remaining 8,848 tons being treated in Canada. These figures show an increase over those of 1896 of 7,448 tons exported to the United States, and a decrease of ore treated at home of some 1,344 tons. The market in the United States has been in a healthy condition, with an active demand and well-sustained prices throughout the year.

In Canada the reduction of the import duty on sulphuric acid has resulted, as feared, in opening our market to the American manufac-

turer, in consequence of which there is a decrease in home production and also lower prices.

The Bureau of Mines of Ontario reports the production of metallic copper to the extent of 2,750 net tons, of a value at the works of $200,067.

Shipments of blister copper to Great Britain are reported by the Hall Mines smelter at Nelson, B.C.

Nickel—The Geological Survey Report for 1897 places the total production in Canada as 3,997,647 lbs., valued at $1,399,176.

Mr. Archibald Blue, Director of Mines of Ontario, reports:—

Nickel ore smelted in 1897	96,094 tons.
Metallic nickel contents	1,969 "
Value at works	$359,651

In certain quarters efforts are being made to induce the Government to impose an export duty upon Canadian nickel.

Gypsum.—The total production for Canada reached 239 691 tons. The output for Nova Scotia and New Brunswick combined reached 150,000 tons.

The other industries such as oil, natural gas, salt, graphite and building materials, show no specially new features, and returns of same are not yet to hand.

COMMERCIAL PROGRESS AS INFLUENCED BY THE DEVELOPMENT OF THE IRON INDUSTRY.*

Commercial prosperity is proportionate to the capacity of a country to produce what is required by its citizens, to its financial ability to sustain these products, and to the facilities for distributing what it is able to supply. Disclaiming any desire to minimize the important bearing upon national advancement which should be credited to the other specialties, the iron industry may be given the leading position. Few articles which we manufacture have been so liberally discussed by political economists as pig iron, and in legislation concerning customs' duties, this product has assumed such a prominent position that we may infer that this particular industry is recognized as exerting a marked influence upon the country and especially certain sections thereof. Facts sustain the inference that probably no one industrial pursuit, except possibly coal mining, has done more to advance the United States than the production of pig iron, and by this product and its subsequent manufacture much assistance has been given to the development of the coal mining industry which now contributes about 71,000,000 tons annually or 30 per cent. of the world's coal output. Having a general knowledge of what has been done towards the establishment of a Canadian iron industry and the efforts to encourage this by Government assistance, some application of the foregoing conclusions to the future of the Dominion may be expected at this time. The suggestions offered are not based upon detailed knowledge of local conditions, for I realize how much better equipped others are to discuss this subject locally. But it may be possible for one whose personal work has included numerous investigations of the adaptability of various locations for the establishment of iron and steel works, and whose examinations have embraced some of the deposits of the Dominion, to present new phases of pig iron production as exemplified in the records of progress of the United States, which may be applied to Canadian development. Canada is well supplied with iron ores, many of them of excellent quality; some have withstood any cost of transportation and paid duty for consumption in the blast furnaces of the United States, several hundred miles from where they were mined. The problem which seems to retard the Canadian industry is the bringing together of satisfactory fuels for smelting and ores of desirable character close to points of distribution or consumption. In determining the advisability of a district or individual location for the production or manufacture of iron or steel, the requirements are. (*a*) The facilities of obtaining raw material of satisfactory character, viz., iron ores, fuel and flux, their cost, and the character of metal which they will produce advantageously; (*b*) the market which can be conveniently reached, or which can be developed and the character of product most in demand; (*c*) the transportation facilities, both existing and prospective, and rates obtainable on raw material and finished products; (*d*) the supply and cost of labor, and the conditions which may cheapen or enhance the wage rate; (*e*) the relation which the local bears to other established concerns which may make similar products, and the competition which must be met from these; (*f*) the character of works which can be constructed, and cost; (*g*) the cost to produce pig iron, and to manufacture iron and steel of the forms most in demand; (*h*) the probability of other locations where no iron is made, but possessing equal, or in some cases superior, advantages, engaging in iron production; (*i*) In countries like the United States and Canada the trend of increasing population demands consideration. The problem is, therefore, by no means a simple one, and in the light of recent concentration of numerous plants under one general management or control this question of ample capital to build up, equip and operate works adds another factor.

*Extracted from a paper read by Jno. Birkinbine, Philadelphia, before the Federated Canadian Institute, Montreal.

In 1897 almost 12,500,000 tons of ore were shipped from Lake Superior mines to furnaces, some of which are 1,500 miles distant, the average distance between mines and furnaces using the ore being probably 800 miles. These ores have gone partly to meet the fuel, but the predominating attraction has been the market afforded for distribution of the metal produced and the articles manufactured from it. A brief summary of the development of the iron industry of the United States may be given in a statement of the rapidly increasing output of pig iron, this being the basis of the entire industry:

Year.	Gross tons of pig iron made.
1810	93,908
1830	165,000
1840	286,903
1850	563,755
1860	821,223
1864	1,014,282
1870	1,665,179
1872	2,548,713
1880	3,835,191
1881	4,144,254
1886	5,683,329
1887	6,417,148
1889	7,603,642
1890	9,203,703
1897	9,652,680

In the past three months the production has been at the rate of 12,000,000 tons per year. Taking the census reports for the half century, the data indicates that the pig iron output of 1890 was over 32 times that of 1840. Improved machinery and technical knowledge applied to iron smelting has done more than anything else to secure the advancement indicated. While pig iron is a most important factor in the development of a district, province or nation, its manufacture cannot be made successful without the use of good business management and technical knowledge. Even with this, failure may follow the location of plants without giving the matter thorough investigation.

Mr. Harvey Graham, who was called upon by the president, agreed with the remarks of Mr. Birkinbine, and drew attention to the immense amount of coal required to make 1,000,000 tons of pig iron per month —say, 2,000,000 tons of coal.

THE CHEMISTRY OF FOUNDRY PRACTICE.

BY ERNST A. SJOSTEDT.

(*Concluded from last issue*).

The powerful influence of sulphur in changing the character and fracture of the pig iron has more than once been forcibly brought to the personal experience of the writer, and an extreme case was met with several years ago at Kathadin Iron Works, Maine, with iron made from a bog ore that contained from 1 to 3 per cent. of sulphur, and which at the time was only imperfectly roasted. Analyses of several samples of all grades of this pig iron—from open gray to white and spongy—revealed the presence of sufficient silicon, which under ordinary circumstances would have made them all gray and soft, but the varying amounts of high sulphur present was here the determining agent, as we see from the following table:

No.	1	2	2	3	3	4	4	5	5	6	6	6	6
Silicon ..	3 05	3.10	2.35	3.55	2.00	2.74	2.70	2.22	1 30	3 89	3.05	2 73	1 00
Sulphur...	.03	.13	.18	.39	.19	.20	.34	.12	.18	.60	.46	.65	.43

Here, thus, we have a white iron with nearly 4 per cent. silicon, which but for the .6 per cent. sulphur present would have shown an open soft gray fracture.

An element we often hear about, and which when present even in the smallest quantity in steel is much dreaded, is *Phosphorous*. In foundry pig, however, a certain small amount is not only permissible, but highly desirable, as it lowers the melting point of the iron and makes it fluid, thus causing it to retain its heat longer and making it suitable for producing small castings of a delicate pattern. Pig iron with less than .2 per cent. P is apt to shrink. But when it is present to over .75 per cent. the iron becomes brittle—this in proportion to an increased percentage of carbon present—and strong castings should not contain over .5 per cent. phosphorous. It unites readily with iron to about 26 per cent., but the pig iron in the market contains from a trace to 1.5 per cent. Phosphorus is not eliminated in the cupola smelting, and its presence should therefore be kept run of.

Manganese is also an element to be taken in consideration in foundry practice, for so many iron ores contain this metal, and a certain

amount enters the iron during the blast furnace process, while part combines with the lime and the sulphur, and is removed with the slag. Its most striking property is to make the iron "chill," *i.e.*, prevents formation of graphitic carbon. But this chill does not make a durable wearing surface, as it is more crystalline than hard, and readily crumbles under the impact of rapid shocks (to which, *e.g.*, a car wheel is subjected). Its presence up to one per cent., however, is not considered detrimental, but a high percentage of manganese makes the casting brittle and white—provided the silicon is not exceptionally high, in which case (as in some Scotch foundry pig of good repute, which carry two to three per cent. of manganese), the graphite is separated, and a gray iron obtained. Iron alloys with manganese in all proportions, and when the amount of manganese runs between 20 and 30 per cent. the product is called ferro-manganese, and when containing from 5 to 20 per cent. it is termed "spiegel" iron. Manganese raises the point of saturation for carbon, *i.e.*, permits of a high total carbon. So while iron without any manganese rarely contains over 4.5 per cent. carbon, ferro-manganese often runs from 5 to 7 per cent. (nearly all of which is in the combined state). Owing to its affinity to sulphur, it acts as a "purifier" (even more so than lime), in the cupola, removing oxides of iron and silicon from the molten iron, and thus helps to prevent blow holes.

A metal which during the last decade has come in great favor as an admixture to iron and steel is *Aluminum*. [The credit of first calling attention to the influence of aluminum on iron castings belongs to a Swedish inventor who introduced the so called "Mitis" castings, a mixture of wrought iron and aluminum]. The principal effect this metal has upon cast iron is that it lowers the melting point of the alloy, consequently increases its fluidity and makes it run quick and sharp, besides giving the gases an opportunity of escaping from the molten iron, hence its reputed property of preventing blow holes. Like silicon, aluminum tends to make a gray iron, and lessens the tendency to chill (*i.e.* favors the formation of graphite), and if allowed to take the place of silicon it will make a stronger and softer casting than if silicon were the agent; but added to an iron already high in silicon it makes it weaker. An addition of aluminum, therefore, is beneficial only to a low silicon pig. If added in sufficient quantities (2 per cent. and more) aluminum, for the same reason as silicon, prevents shrinkage.

Other elements, such as titanium, arsenic, copper, nickel, chromium, etc., also exert their influence on the character of the iron, but they rarely occur in sufficient quantities to require looking for.

From what already has been said, it follows that carbon is a necessary, but passive component in the pig iron, made to change in amount and in form by the presence of other elements. Thus sulphur and aluminum tend to change the carbon into graphite, while sulphur, manganese and phosphorous do not cause carbon to leave its combined state. Sulphur, manganese and combined carbon increase the tendency to shrinkage, while silicon and phosphorous help to counteract this evil, and the more of the effective element the iron contains the more is its action facilitated or retarded, as the case may be.

According to the state in which the carbon is present in the pig iron its grading is determined; but as we have also seen how largely the proportional amounts of graphite and combined carbon are dependent on the many foreign elements present, and to a great extent also on the conditions under which the metal has been allowed to cool, it will at once be evident how uncertain and unsatisfactory it must be to try to judge the quality of the iron simply from the fracture it presents. On the other hand, it is not claimed that the physical properties of an iron are wholly dependent on a certain chemical composition, for there are several possible and proper compositions for an iron intended for any certain purpose, "each of which depends for its physical success on the manner of working the iron, as the full blast, temperature, etc., and on the relative proportions of one element to another, as well as on the actual amount ot each present." But before we institute chemical investigations we do not gain a true knowledge of what *causes* these different physical qualities in the iron, nor is it otherwise possible to ascertain the true composition of the pig iron or the cupola charge. In trying to remedy any evil, the first step to be taken, after all, is in the direction of discovering the *cause*, after which a restorative generally can be found. And, as said at the Foundrymen's Association in Philadelphia some time since, "in forming his deductions the chemist's mode of procedure is singularly simple, reasonable and practical. As a result of years of scientific experience, theory and actual practice, it is known that certain impurities in the material produce certain characteristic effects on its physical behavior; and these impurities may be eliminated, retained, or forced into combinations with others, according to fixed laws and conditions to which they are subject. There are founders who can get along without chemical services, but there are very few who could not obtain practical benefit from a use of the knowledge now obtainable upon this subject."

Montreal, February 10th, 1896.

THE STEAM ENGINE.

Editor CANADIAN ENGINEER:

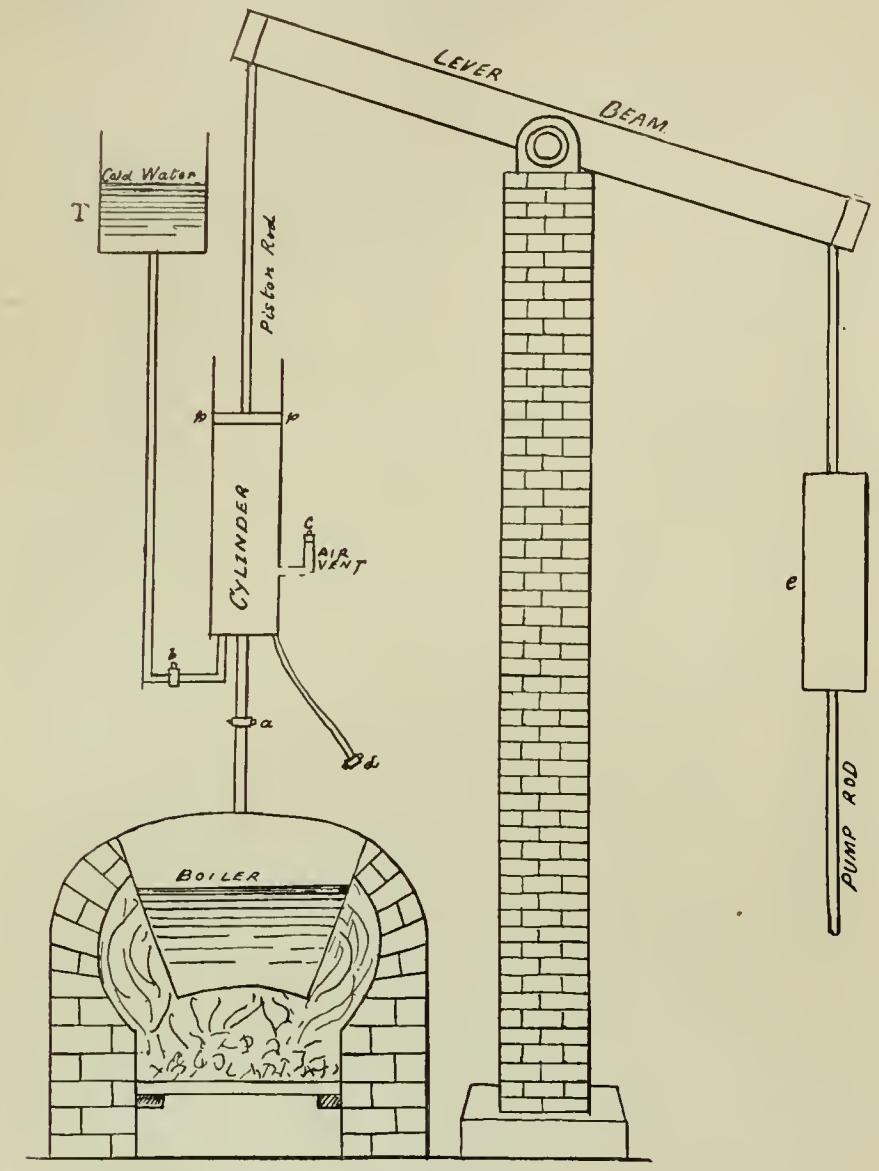
My last letter to you was on the setting of boilers In this paper I propose to speak to the young engineers and readers of your valuable journal, THE CANADIAN ENGINEER, and address them as my sons. I will now draw your attention to the horse-power, or the power of a horse and the duty which may be expected from a horse day after day; the power and duty of a steam engine or any and every machine has been and is now measured and compared with the power and duty of a horse as a unit.

Sixty years ago I was fifteen years of age and had served the first year of my seven years' apprenticeship in the boiler shop of one of the largest foundries in the west of England. My second year was designed to be spent in the erecting shop, so I had to spend much of my time among the mines taking down old and putting up new engines and machinery. My curiosity was aroused in looking through the storerooms of the mines. I saw many old tools and parts of machines. I made enquiry about their use. There in a corner lay an old leather bag or bucket, likely it had not been moved for many years. Being inquisitive, I asked the old storekeeper its use, and how long it had been there? He said, "many years ago, when I was a young man, about the close of the last century, 1790, instead of having an engine to pump the water from this mine, as you are now taking out, and the large new one you are about to put in, we had to draw it out with this leather bucket. A rope over a large pulley drawn by a horse, a heavy framework of timbers stood over this shaft with a large pulley on the top, and over that road the horse used to travel drawing the rope over it. A slow motion, but it had to be kept going. When one horse's eight hours were up another took its place, which would not keep the mine clear of water, being much deeper now and more men employed in bringing up the copper." Now a good reason was given for using leather bags. It would not knock down anything which happened to be loose on the side of the shaft, for the miners went up and down the same shaft. If the ore was brought up the same shaft it was made large enough to bare in a part for the iron bucket or cibble to pass up and down. Another pulley was provided and placed in the framework over the shaft for a chain to pass over in a groove.

The miners did not then go up and down in elevators as now, but had ladders placed perpendicularly fastened to the side of the shaft with iron rungs, and about every 100 feet a resting floor was made for them. I well recollect, after coming up six hundred feet over such a ladder, I was tired enough. The miners wore hard felt hats with wide brims to protect their heads and shoulders, with a piece of clay stuck on the brim and with a candle in it to give them light. There were no matches and Davey lamps as there have been since; it was a very unfortunate thing for them to lose their light. I one time went into a place like a large room; there was not sufficient air to feed it. My light was gone, all was dark; I had to grope my way to the nearest wise man, whose light still burned (you young men be sure you do not get into such a position with your excited mining speculations). It is very nice to hear the voices of the miners coming up the shaft, singing some well-known tune in their lively meeting houses and keeping time with their feet on the thaves of the ladders as they go up and down, and sometimes at their work, to go through a well regulated mine and ramble through long tunnels, observe the way they work to get out the ore; sometimes it is not all pleasure nor profit to the worker, nor investor—but I have wandered off, I must return to my text.

The horse power, and his duty drawing up water for eight hours per day, was an important subject in the year 1698. Some 300 years ago Captain Savery obtained a patent for a steam engine, to draw up or force up with a pump the water from the mine instead of the horse arrangement, he called it the miners' friend, and after he had it going he found his engine would force up as much water as twelve horses in a day, then he called it so many horse-power. Their cost also had to be compared, to calculate the advantage of using steam (that great natural force they had learned to bridle and harness); it soon became noised through the mines and country that the horse had been superseded by the steam engine, for it could run night and day for less cost than the three horses. The excitement caused a number of the thinking men to turn their attention to making steam turn the mills, factories and other machinery. Companies were formed and a great deal of money spent. Newcomen, Cowley and Savery formed one company in England, others in Scotland built foundries. Steam was the great topic of the day. This Newcomen Company got seven teams of horses in a field, in a ploughing match. It was found the average weight a horse could draw through the day was 163 pounds,

and travel 2½ miles per hour. Another trial was made by them some time after with 144 horses drawing a weight with a rope over a pulley eight hours per day, to be on the average 150 pounds, and traveling 2½ miles per hour; but the most direct way for them to get at the



NEWCOMEN ENGINE.

(*a*) Stopcock between boiler and cylinder; (*b*) Stopcock between cold wate tank and cylinder; (*c*) Valve closing air-vent; (*d*) Valve closing the outlet for con densed steam; (*e*) Weight which drags down the beam; (*pp*) Piston which is pressed down by the atmosphere when the cylinder is empty.

power of their engine was to find how many gallons of water a horse could draw up in eight hours out of a mine so many feet deep, which they did, and found their engine would force up as many as 100 horses in the time; the horse-power to them then became their unit or standard for making their engines.

In 1705 this Newcomen Company was formed. Newcomen, being a very active man in business, made a model engine for the University of Glasgow of brass about the year 1710; the cylinder was two inches diameter, six inches stroke (this engine had some improvements over Savery's); the boiler was made of copper, nine inches diameter, without a safety valve. At times the steam rose too high, 75 to 100 lbs. per square inch, but had to be governed by the regulation of the fire. The cylinder of this engine stood directly over the boiler, and was connected by the steam-pipe. This cylinder had a bottom, but no cover for the top, so that the piston could be seen and the air-press on the top of it. This pressure of about 114½ lbs. per square inch is the power of the engine. The cylinder being 2 inches by 2 inches by 7,854 = to 3.1416 square inches on the piston, by 14½ lbs. atmospheric pressure, gives about 45½ lbs. on the piston, so that whatever size engine was required the size of the piston was given and number of pounds expected of it, providing the piston was airtight in the cylinder, and a good vacuum was formed under it by the steam raising the piston up again. The steam was then condensed and the cylinder cooled by a spray of cold water let in, and was let off from the cylinder. A part of this warm water was used to feed the boiler. The tap or valves had to be opened and shut by hand every stroke. One day the boy, Humphrey Potter, wanted to be relieved of his duties; he saw he could tie a lever and a string to the working main beam to do his work. The piston rod was fastened by a chain to a wood beam one end and the other end to the water pump. To such ingenious boys we are greatly indebted for our many improvements we have to-day. This engine remained in the museum of the University for many years. A number of professors and students looked at it and passed by. Sixteen years after it was made, a little boy was born in Greenock; his father rejoiced and said he had a man from the Lord, and called his name James Watt, 1736. Being a mechanical ship-builder, he trained his boy to be mechanical, too, by giving him tools to use when out of school. Being rather weakly, his mother kept him home and taught him good, scientific knowledge and honest principles. At the age of 12 years he was found by his aunt in her kitchen, watching the steam coming out of the spout of the kettle; he stopped it from coming through the spout and put a weight on the cover to see what it would do. The steam rose and blew off the cover, and some of the water into the fire. This caused his aunt to come and see what had happened. She scolded him for wasting his time and the water she wanted and told him to go home to his mother. Her displeasure did not stop his thinking about the much talked of steam among boys and men; of what it was doing in the mines taking the place of the horses. At the age of 16 years, Watt was sent to London to learn the art of a mathematical instrument maker, that was then one who made clocks, fishing tackle, sailors' compasses, quadrants, doctors' tools, university and school instruments, and a variety of things to be repaired. At the age of 21—1757—he left London and went to Glasgow, opened a little repair shop for anything he could get any money by, for he had to depend on his own income, as his friends were much reduced by heavy losses. The professors and students of the university visited his shop for repairs; that same year he was appointed instrument maker, and had rooms provided for him in the University of Glasgow. Among many other tools he had to repair was Newcomen's engine, and to see further what it could be made to do, as for 47 years little had been done with it. He soon discovered its great defects and what was wanted, he found it took six pounds of cold water to condense one pound of steam (one pound of water will make one pound of steam) and cool the cylinder so as to form the vacuum required; the great idea struck him if he could keep the cylinder hot and get clear of the steam, he could put a cover on the top and cause the piston to descend by the steam with much greater pressure than by the air 14½ lbs. His mind seemed to be fully occupied, that he could not think about anything else. One Sunday morning as he was going to church his hands were not engaged, but his mind was fully absorbed about the engine; a voice seemed to sound in his ears from someone beside him, "get another cylinder and carry the steam from the top and the bottom of the piston and condense it there with a spray or jet of cold water; your engine will go faster and be of much greater power, as the steam can be raised much higher by having a larger and stronger boiler;" everything seemed to be clearly marked out before him for a real steam engine to be used in factories, steamboats and land carriages. He became much excited over the vision in his mind, he could not follow the preacher in his sermon. A very great obstacle stood in his way, that was, the money it would cost to try his plans; he drew his plans and talked it over with Dr. Black, Dr. Roebuck, Dr. Ure and other friends, who agreed to assist him. He then withdrew from the University and devoted his time getting out his patterns and castings to get his engine to work. Here we had better let him carry out his plans, and we will observe him going from pattern to molding shops, machine to erecting shops, directing his workmen until his engine is finished and working. Dr. Roebuck and other friends provided the money and gave him room in the Carron Iron Works.

In summing up our standard of measure or unit we now call the horse-power. We must borrow an idea from Mr. Watt, and make our figures and calculations as simple as possible. I will now suppose the water in the mine to be about 206¼ feet to be drawn up, the bucket and rope to weigh about 125 lbs., and the water 287½ lbs., 28¾ gallons, or the whole 412½ lbs. The rope and bucket will descend by gravitation. The travel of the horse for the first draw will be 206¼ × 2 = 412½ feet, and if this be continued ten times per hour will give 4,127½ feet for the horse to travel and 4,127½ lbs. to draw, and if continued for eight hours a day, which is considered a day's work or the duty of a good horse, will give 33,000 lbs. drawn up over a pulley 33,000 feet or 6¼ miles per day. This gives 1 lb. to the foot, or as it is now called, a foot pound. If a horse could raise 33,000 lbs. one foot in a minute it would be considered a day's work, or the duty expected from him for a day's pay, as much as if he had taken eight hours. This is called the nominal horse power, and if a machine, steam or moved by any other force, can be made to do or exert that amount of force or work in one minute, or eight hours, it is called one nominal horse power, or if it can exert 100 horse-power in a minute it is called 100 nominal horse-power.

In bringing this subject to a close I think it wise to lay before you the cost of raising 33,000 lbs. or 2,300 gallons out of the mine 206¼ feet deep, and the horse has traveled 33,000 feet in eight hours. The horse should be well stabled and fed with an allowance of 25 lbs. chopped hay and a half a bushel of oats, beans and bran ground, about 40c. per day, a man's wages $1 for attending to it, and other expenses $1.50 per day. The first outlay equals about $300, interest $18.

In this paper we have seen a little into the workings of the steam and the atmospheric engine; in my next paper, if you, Mr. Editor, can find room for the little light I can bring before the readers of your valuable journal, I propose to follow our dear old friend, Jas. Watt, with his improvements, and trace down a little of what has been done since his death in 1819.

Yours truly,

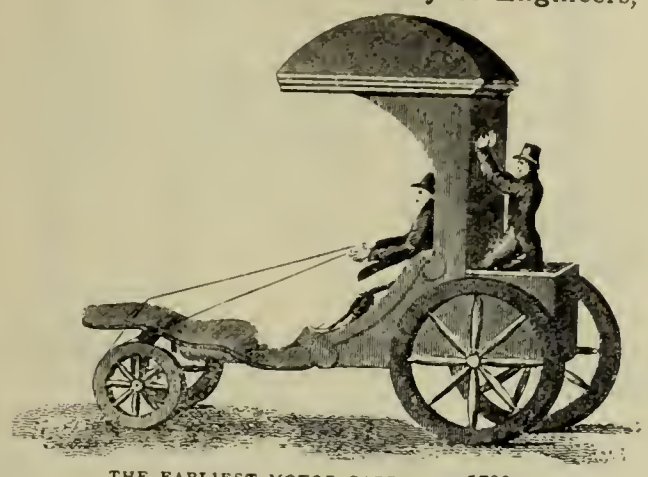
P. T. TROWERN,

Feb. 15th, 1898. Chief Engineer Asylum for Insane, Toronto

THE MOTOR CARRIAGE.

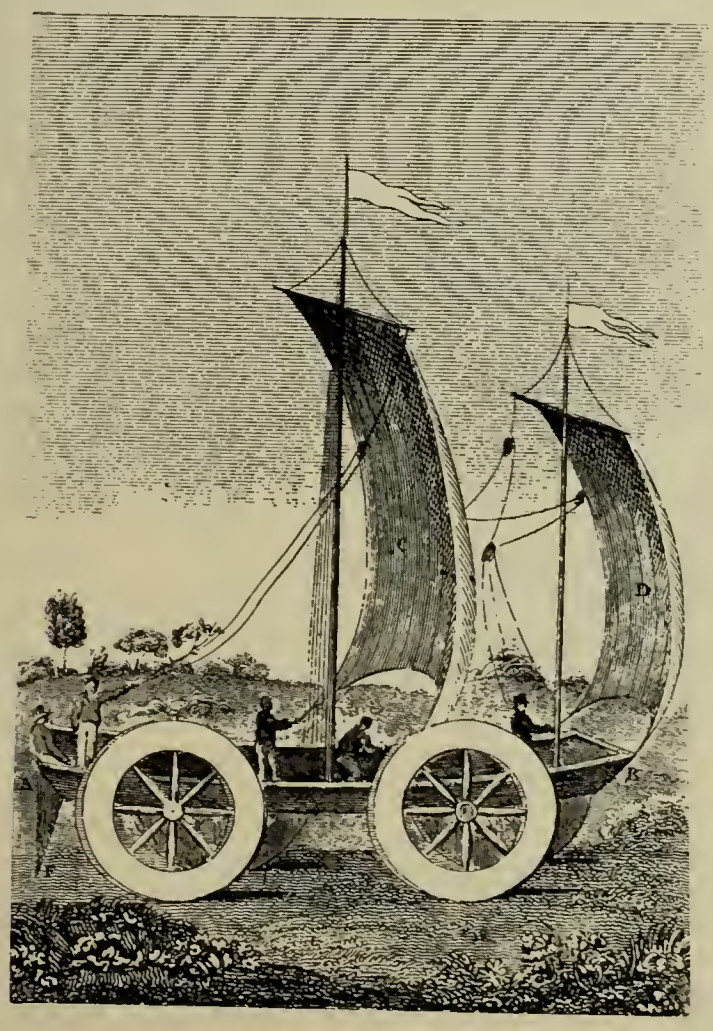
PAST AND PRESENT.

"With the exception of lands and ruins, there are few material things of value to man which do not derive that value, in part at least, from transport from their original position Cheap means of transport is one of the most important of all the subjects occupying engineers to-day, and one which offers, as it has always done, one of the most profitable sources of investment."—Worby Beaumont, M. Inst. C.E., M. Inst. M.E., M. Inst. E.E., President of the Society of Engineers, England



THE EARLIEST MOTOR CARRIAGE—1796.

The earliest motor carriage—a hundred years ago. The carriage shown was not strictly an autocar or automobile, but rather a manomotor, and the man who "moted" was in a double sense a footman. The pedals are crude bicycle pedals, therefore this curious old engraving represents the ancestor not only of the modern motor-carriage, but of the bicycle. As for the sailing chariot* or airmotor, the present-day prairie schooners would stand no chance in a cyclone-race with this Flying Dutchman. It was, too, picturesque, and had no massive storage batteries to be charged; no ponderous fly-wheels—though



THE SAILING CHARIOT.

This chariot was constructed in the last century by Stephinus, at Scheveling, in Holland, and would carry 8 or 10 persons from Scheveling to Putten, 42 English miles, in 2 hours. The wheels require to be farther asunder, and the axletrees longer than in ordinary carriages, to prevent overturning. Carriages of this kind are said to be frequent in China. In any wide level country their use must be sometimes both pleasant and profitable, when the wind is right.

all four wheels fly; no water-jacket; no missing of explosions; no odors to offend the passers-by, or noise of escaping steam or exhausting gases to frighten horses. Of course if the wind happened to be in the wrong quarter, the ship simply lay-to and "waited the turn of the tide." So much for the past: these old engravings certainly mark the first definite attempts at the solution of the motor-carriage problem, and it is with pardonable pride THE CANADIAN ENGINEER presents them for the first time.

What about the present? It is a time of unwonted activity among the inventors, engineers and mechanics. Thousands of the brightest brains in the world are struggling with the complicated problem of mechanical traction. Engineers who have made a special study of this question are aware of the peculiar difficulties it presents. That mechanical skill will finally triumph we firmly believe; and as seven cities claimed the honor of Homer's nativity, so will all civilized countries do homage to the genius who with seven-league boots shall stride in this mechanical Klondyke and show the world the way.

THE LATEST MOTOR CARRIAGE,—1898.

One of the most hard-working students of the motor problem is W. J. Still, who for nearly seven years has been experimenting in Toronto with the various types. The history of his failures would make interesting and profitable reading, but it is only of his success we have room to tell. Mr. Still's first experiments were with electricity, but although his work in this

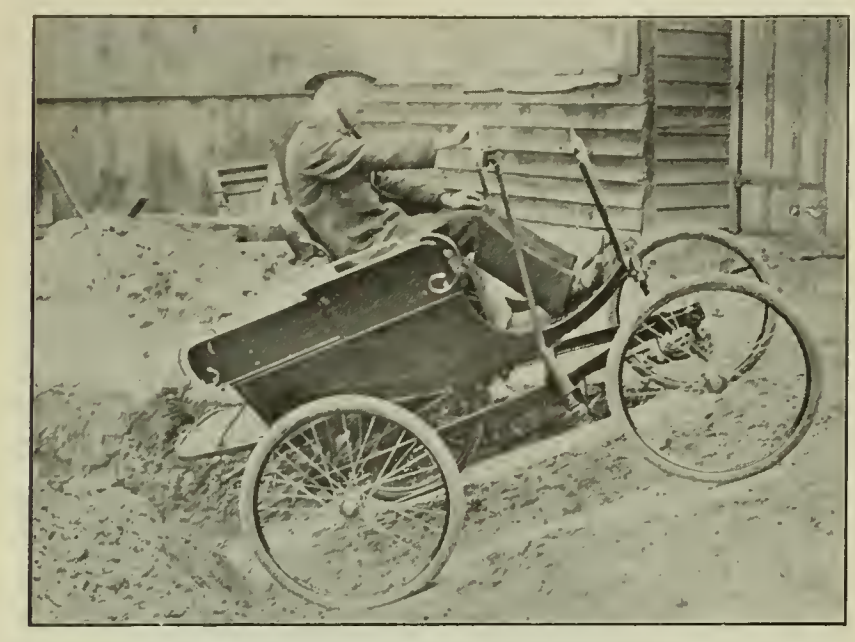
CANADIAN MOTOR CARRIAGE.

Front view, showing steering gear and controller. Hand wheel used for steering. Mr. Bengough at wheel; Mr. Still to his left. Weight of motor, 3.0 lbs. Entire weight of carriage (unloaded), 750 lbs. Power of motor, 5 h.p.

connection encouraged the young inventor, he fully recognized that electricity has severe limitations, the most serious of which is the absolute necessity for recharging. This consideration

*For the engravings of the "Earliest Motor Carriage, 1798," and the "Sailing Chariot," we are indebted to Thomas Bengough, of Toronto, who, having the motor-mania, and being a book collector, recently captured the precious old volume containing the original engravings on steel.

alone puts the storage battery out of the race for running through districts where charging stations do not exist. Mr. Still's attention was therefore turned to gasolene engine construction, and following his radical bent, he determined to avoid altogether the weak points of all gasolene engines, viz., rapid piston movement, complicated cycles, and differential gearing: fo these features involve practically all the troubles that beset the motor carriages to-day. The sequence is made up thus:

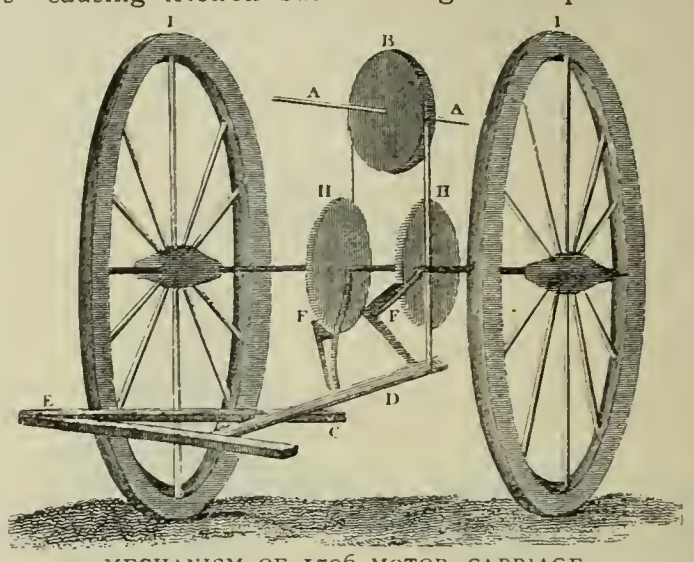


CANADIAN MOTOR CARRIAGE.

On grade specially constructed to scale of 1 in 3. As soil was soft, boards were laid for wheels so as to reduce tractive force and make test as severe as possible Brakes had not been fitted to rig when photo. was taken, and carriage is held in position by its own motive power.

(1) Rapid piston movement—600 to 1,000 revolutions per minute—causing immense heat, often up to 1,500 deg. or 2,000 deg. Fah.; this high temperature in turn necessitates the use of heavy oils, which at great heat give off bad odors. It also requires a water jacket and cooling water tank, with pipe system for circulation of water and radiation of heat. All these points involve great size, weight, and cumbrousness in proportion to load. (2) The complicated cycles, in which frequent misfires occur, involve very bad odor by the unused gas being emitted through the exhaust. The piston thus receiving no impetus, a heavy fly-wheel is essential, and this adds further weight and clumsiness. (3) The elaborate series of differential gearing add immensely to size, with no advantage except varying the speed of transmission. Sir David Salomons considers all differential gearing such a nuisance that he frankly says were he a manufacturer he would willingly give £20,000 to be entirely rid of it. Following on the heels of the heavy and complicated mechanical construction above noted, come noise and vibration. There also comes a loss of power in proportion to size and weight of mechanism. The highest record of power exerted by a motor carriage up to date was 187 pounds draw-bar strain, while the carriage (unloaded) weighed over 1,200 pounds. A good horse—such as Watt used to obtain his standard "horse-power"—will pull 400 pounds; therefore, 187 pounds is less than one-half horse-power.

To remove at one stroke all this complication, with consequent losses and disadvantages, was the herculean task to which the young inventor set himself. The essential point was to discover or invent a new cycle. There must be no "false motions" causing friction but resulting in no power. There



MECHANISM OF 1796 MOTOR CARRIAGE.

This carriage was exhibited in Paris, France, last century, by Dr. Richard, of Rochelle. When the footman presses down one of the treadles, suppose C, with his foot, he brings down one of the pieces of iron, F, and consequently turns the wheel H, that is next to it. At the same time, by means of the rope that runs over the pulley B, he raises the other treadle D, together with its piece F, which, being thrust down, will turn the other wheel H, and so alternately; and as the great wheels are fixed on the same axis, they must necessarily move at the same time.

must be no mechanical absurdity, such as is involved in the process of creating intense heat and then taking it away by a cumbrous round-about process of cooling. There must be a further feature superadded, which does not exist in any gas or gasolene engine; which exists in a limited area in the storage battery, which is found in perfect form in the steam engine: that feature being the ability to give off for short periods much more than normal power. In the case, for example, of the carriage referred to, 187 pounds would be easily sufficient to propel 1,200 lbs. on a level, but what would happen when a hill is reached? Sir David Salomons, one of the greatest, because most disinterested authorities on the autocar question, lays down this rule as to power of motors for carriages: "If twelve miles per hour be fixed as the speed of a vehicle weighing, when laden, say one ton, then the power of the carriage should be sufficient to run at this in all weathers and over all highways, and to climb every hill with a maximum ascent of, say, one in ten, at the proposed rate. The vehicle should also be able to mount a hill of one in five, but at less speed.....I have come to the conclusion that, for every ton, not less than ten horse-power should be carried." This, it will be noticed, is the exact proportion of power developed in the Canadian motor carriage. Sir David continues: "This does not necessarily imply that a ten horse-power engine is required. It means that the engine shall, for considerable periods, and without injury to itself, be able to give off 10 h.p. It must be remembered that when the carriage is started, a far larger amount of power is necessary than when it is running. It is therefore very important to have a good reserve." Sir David then quotes valuable figures to show the varying power needed according to the grade, taking

PASSENGER AND PARCELS AUTOCAR

Now under construction by Canadian Motor Syndicate for the St Germain Autocar Line. Scale of drawing, ¼ in. = 1 foot. Van to seat 25 passengers; equipped with motors producing 20 h.p.; capable of ascending all grades up to 1 foot in 3; lighted by electric light; furnished with special indicator, for motorman; strong, effective brakes of two separate designs; seats to be handsomely upholstered; windows to have automatic spring roller blinds; roof railed for parcels.

a stage coach weighing 1,800 pounds, exclusive of passengers, thus :

Grade of 1 in 40, 6 miles per hour, required ....160 lbs.
" 1 in 30 " " .....165 lbs.
" 1 in 26 " " .....213 lbs.
" 1 in 20 " " .....268 lbs.
" 1 in 40, 10 miles per hour, requires....172 lbs.
" 1 in 30 " " .....200 lbs.
" 1 in 20 " " .....318 lbs.

On this point it may be interesting to quote from Mr. Worby Beaumont, whose quotation heads this article: "The increase in the power required to haul a load up a hill is directly proportional to the angle of inclination from the horizontal, and hence on a hill of one in twenty, a very common gradient, the hauling power jumps from the average, on a good macadam road, of say 45 lbs. per ton to 51 + 125 lbs., or a total of 157 lbs. instead of 45 lbs. Bad as this is, it is insignificant as compared with the pull required on a gradient of one in ten to one in eight, not at all unfrequently met with. On one in ten the hauling power required becomes 269 lbs. instead of 45 lbs., or no less than six times the power required on the average nearly level road. It is to meet this heavy demand for power that two or three horses have often to be sent with a load which, but for the one or two short lengths of steep hill, could be taken by one horse, and it makes it necessary to put on a motor vehicle boiler and engine power of from 12 to 16 horse-power, where from three to four horse-power would be sufficient."

Mr. Still set himself to solve this difficult problem, the peculiarity of which not even engineers understand who have not studied it in detail; for it must be remembered that the addition to a motor carriage of the boiler and engine power spoken of by Mr. Beaumont would in itself be fatal to the actual work of the motor carriage. Mr. Still's aim was to secure a draw-bar strain equal at least to one-half the total weight of the vehicle. His system is practically in itself a differential gearing of unlimited scope. It allows of a speed gear from the motor, beginning at the ratio of 1 to 1, and running to an almost unlimited scope, certainly over 120 to 1—the latter range having been actually reached in shop tests; this being entirely automatic according to the draw-bar strain required, and without any dividing line on either ascending or descending scale, and without belt, friction or gear-drive.

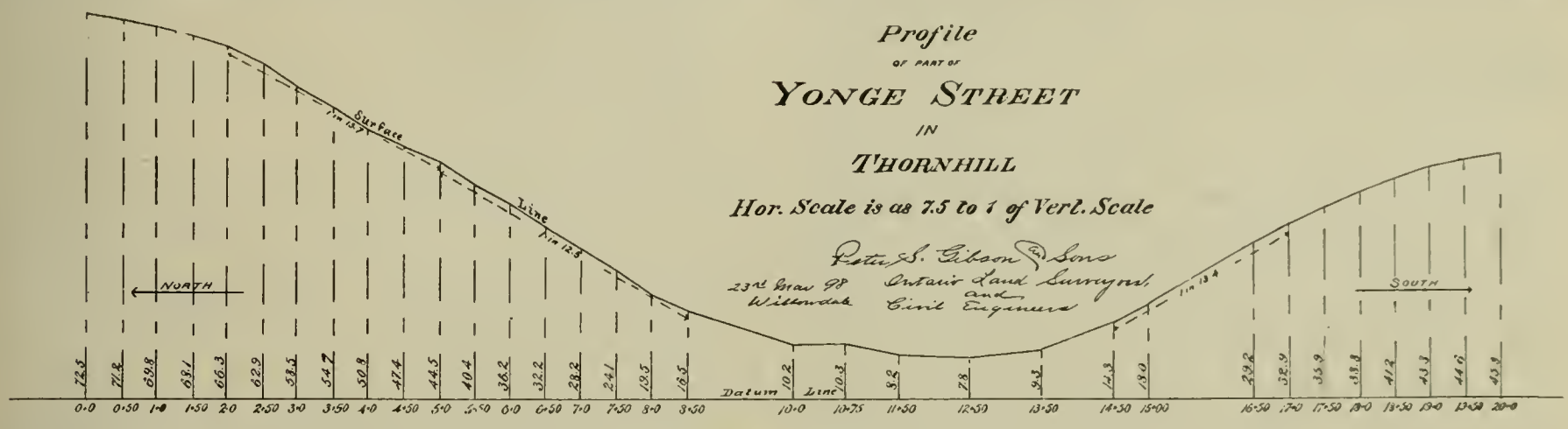
The Still system of motor power as it stands to-day, is unique in the fact of being able to place and maintain a rig in any desired position on any grade. This feature is admirably shown in the photograph representing the carriage standing on a grade of 1 in 3, the draw-bar strain being exactly proportioned to gravity and friction. No brake is involved in the operation: it is simply a question of a balance of the motive force; and about 20 lbs. in either direction would have overcome the balance and moved this rig, although at the time in question the outside draw-bar strain necessary would amount to about 270 lbs. This same force can also be used for sudden stopping in descending grades in case of emergency, and would not only stop a carriage, but rapidly propel it backwards the moment sufficient tractive force were obtained to stop the wheels from skidding. The control is simple. You simply push the controller forward if you wish to go forward; if you wish to go faster, you push it further forward; if you wish to stop, you pull the controller back; if you wish to reverse, a small lever, movable to the left hand, if pulled towards the rear, reverses the mechanism. This can, if necessary, be done at full speed without injury to the machinery. Steering is controlled by a hand-wheel on the controlling lever. Two separate powerful brakes are also provided, one operated by the foot and one by the left hand. Mr. Still's motor is a new departure. There is no sound of an exhaust; there is no odor of combustion, there is no heat; there is no necessity for the cooling water-jacket. In the rig as now standing, there is no water used or required. High speeds can be maintained, or the governor can be so adjusted that no speed above a certain maximum can be obtained, so that in case of delivery vehicles driven by careless Jehus, reckless driving will be impossible.

The motors used in this vehicle may be extended along the whole line, from a small bicycle unit to the unit necessary to drive ocean liners, including invalid chairs, all kinds of road vehicles, launches, street cars, railway engines and stationary engines.

It will be noted that the machinery in connection with the Canadian motor carriage is almost invisible, and not a line of the construction of the body has been changed. This carriage body is one of the regular make of the Canada Carriage Company, Brockville. Nothing has been done with it excepting that part of the flooring has been removed to allow room for the motor. The total weight of the engine is 300 lbs ; engine and truck together (including wheels), weigh 600 lbs.; the body of the carriage, controller and springs, add about 150 lbs., so that the total weight complete without load is 750 lbs. The load shown in the engraving (4 persons) is somewhat over 600 lbs. The carriage would easily accommodate its equal weight of load. Thus the proportion of weight to load is reduced to pound for pound, which is a reduction of about three-quarters of the ordinary weight of motor carriages. The power of this 300 lb. engine is equivalent to five horse-power. Thus the Canadian motor carriage combines the maximum power with minimum weight, and marks an epoch in motor carriage construction. A sudden development of the motor carriage industry in Canada has come within the past month. A. H. St. Germain, of North Toronto, has for over a year past been investigating the question of autocars, with a view of putting a service on the line between the city of Toronto and Richmond Hill, the service of the Metropolitan Street Railway up Yonge street—the main thoroughfare of the County of York—being very unsatisfactory. Mr. St. Germain is a wealthy gentleman, who lives at Bedford Park, about four miles north of the city, and he has personally suffered with others the inconvenience of the irregular service given by the Metropolitan Line. He had been corresponding with English autocar makers in reference to a number of storage battery omnibuses, but after having a private view of the Still engine as running upon the truck before the Gladstone carriage shown in the engraving was completed, Mr. St. Germain was convinced that his was the power he needed, and at once closed a contract with the Canadian Motor Syndicate, who control the Canadian business in connection with Mr. Still's inventions. This contract provides for the immediate construction of an autocar such as shown in the large engraving published herewith. This autocar is being constructed with all possible speed, and will take the road in the early summer. The following are the main features of the construction contract for the St. Germain autocar:

"Van to seat 25 passengers; equipped with motors producing 20 horse-power; capable of ascending all grades up to 30 per cent., lighted by electric light; furnished with buttons and special indicator by which motorman may be ordered to move to right or left boulevard, or stop suddenly; strong, effective brakes of two separate designs; seats on either side of middle aisle to be handsomely upholstered; windows to have automatic spring roller blinds; roof railed for parcels; everything to be of the best style and workmanship."

The route of the St. Germain autocar is a particularly difficult one, as can be seen by an examination of the profile prepared by the Township Engineer, Peter S. Gibson. It was



impossible to give in our limited space a profile of the whole line, covering ten miles, but a selection was made of one of the steepest grades, that near Thornhill. It will be seen by the figures upon the profile that this grade amounts to 8 and 10 per cent. These grades would require (as shown by the above extract from Mr. Worby Beaumont) a hauling power "six times that required on an average nearly level road." It must be remembered, too, that the conveyance which is to run over these immense grades is not an ordinary road carriage carrying from one to four people, but is a passenger and parcels van, seated for 25 persons, in addition to baggage on the roof. No such van is now running in any part of the world; and it speaks volumes for the courage of the promoters of the Canadian Motor Syndicate that they should be prepared to undertake such a task. Mr. Still, however, with an autocar equipped with his engines, capable of 20 horse-power, and being built also to exert this power much beyond the normal rates in times of emergency, is satisfied that the car will be able to surmount them without the slightest difficulty. The two motors, although small, will be placed immediately over or next the axles; every wheel will be a driving wheel, and the aggregate power which will be at the command of the motorman will be equivalent to 2,000 lbs. draw-bar strain—each of the motors being capable of 500 pounds draw-bar strain. This latter is the figure already reached in various tests of the motor with which the small Gladstone carriage is equipped.

It is interesting to note in connection with the name of Mr. St. Germain, the promoter of the Pioneer line of Autocars, that the town of St. Germain in France, about 17 miles from Paris, had the honor of possessing the first railway in France; and true to its traditions, it was also the first to carry out trials of mechanical vehicles for public transport. A company has been formed in that ancient town to start a line of autocars between St. Germain and Ecquevilly, with a prolongation eventually to Nantes. Mr. St. Germain, although past the allotted three-score and ten, has shown great enterprise and enthusiasm in this matter, and is keeping the Canadian public posted constantly as to his proposed autocar service. He has purchased an interest in the Canadian Motor Syndicate, and to show his confidence and good faith in the enterprise, has on deposit the sum of $100,000 to invest in the autocar business.

The president of the Canadian Motor Syndicate is Thomas Bengough, court stenographer, Toronto; the mechanical engineer is W. J. Still, and the secretary is L. W. Dorling. At present writing, the business is being rapidly developed, patents having been applied for in all countries of the world covering the inventions of Mr. Still, and negotiations are in progress for increased factory accommodation.

CANADIAN ASSOCIATIONOF STATIONARY ENGINEERS.

On March 8th, Inspector St. John, of the Boiler Inspection and Insurance Company, delivered an interesting and instructive lecture before the Toronto No. 1 C.A.S.E., on the strength of materials in boilers.

The regular meeting of Toronto No. 1, Wednesday, March 16th, was one of the best held this winter. The question box was full, and Bros. Fox, Barman, Mosely and Wickens took part in answering in a very full and instructive manner.

The Hamilton branch of the C.A.S.E. held an open meeting recently in their hall. Quite a large number of the members attended and although through some misconception no regular paper was read some very interesting questions dealing with boilers, engines, machinery, etc, were discussed. In answer to one question as to whether more fuel is used in running two small engines instead of one large one, it has been proved that a large engine of, say, 150 horse-power uses considerably less fuel than two of 75 horse-power. This is owing principally to the fact that more heat is carried off in radiation in using the two than in the one. In cases of electric light plants, power houses, etc., it is often desirable to have two small engines instead of a large one, so that if anything happens to one the power need not be stopped as they will have the other to fall back on. The annual banquet of the Hamilton branch will be held in April.

At a meeting of the London branch C.A.S.E., held in Sherwood Hall recently, a lengthy discussion took place on Electric Motors and Steam Boilers, in which all members took part. Some time ago a pamphlet was issued by the examining board, Messrs. Risler, Bright, Goldart and McLean, with a number of engineering questions to be solved. Two prizes were offered for the best answered paper. D. J Campbell was awarded first prize, $8, and D. McKinley second, $5.

Industrial Notes.

YARMOUTH, N.S., is to have a $12,000 school building.

THE village of Hintonburg, a suburb of Ottawa, is to have waterworks.

M. MOORE, Chatham, Ont, purposes to start a canning factory in Berlin, Ont.

A LARGE saw mill is to be erected at Tusket Wedge, N.S., by J. H. Pothier & Co.

TENDERS are being asked for the building of a waterworks system in Port Colborne.

ST. PATRICK'S CHURCH, Ottawa, Ont., is to be improved this year at a cost of $50,000.

PLANS are being prepared for a new Y.M.C A. building at Winnipeg to cost $50,000.

THE Guelph, Ont., Foundry Co has been organized to manufacture hot air furnaces.

WM. MCKENZIE, Toronto, has become a director of the Calcium Carbide Co., St. Catharines.

A MONTREALER interested in the iron trade is negotiating to buy the Kingston Locomotive Works.

A BUILDING permit has been taken out for a brick addition to the Greening Wire Works, Hamilton.

M. BEATTY & SONS shipped two hoisting engines to Ryan & MacDonald, Dominique, Que., recently.

CITY ENGINEER BARROW, Hamilton, Ont., has planned an $18,000 trunk sewer, to be built this summer.

THE Canadian Typograph Co., Windsor, Ont., has shipped 400 bicycles to South Africa this season.

G. BROWN, Westmeath, Ont., is building the bridge across Coulonge River, near Coulonge, Que., at $6,000.

AT the annual meeting of the Belleville, Ont., Gas Co, on the 12th ult., J. W. Johnson was elected president.

I. USHER & SONS are putting in a new one hundred horse-power engine in their cement mills, at Queenston, Ont.

THE filters installed in the Renfrew, Ont., water-works by J. McDougall, Montreal, have been successfully tested

THE Wm English Canoe Company, Peterborough, Ont., shipped twenty-four canoes to the Yukon in one week recently.

T. L. WILLSON, of the Calcium Carbide Co., Merritton, Ont., will, it is said, build large works near Montmorency, Que.

BLONDE BROS., Chatham, Ont., will build the Kent County House of Refuge at their tender of $14,421 for the building complete.

THE Columbia Handle Company, Thamesville, Ont, has moved its plant to London, Ont., and is located in the old London East G.T R freight sheds.

THE Massey-Harris Co., Limited, Brantford, Ont., will spend $25,000 on enlargement of their works, and will also greatly enlarge the Toronto factories.

THE Hamilton, Ont., Blast Furnace Company during the past winter took three thousand tons of iron ore from the township of Darling, Lanark county, Ont.

FREE instruction will in future be given in sheet metal pattern cutting in the rooms of the Sheet Metal Workers' Union, Toronto. All sheet metal workers of the city are invited to attend.

J. L. GOODHUE & Co., belt manufacturers, Danville, Que, are completing a number of large belts for a new mill on the Pacific coast, consisting of one 48 feet double, two 20 feet double, two 18 feet double and the smaller belts required.

ARTHUR DENISON, architect, Toronto, has taken out a permit, on behalf of the Cawthra estate, for the erection of a $50,000 store building, to be erected according to his plans on the old John Eaton Co 's site, corner of Yonge and Temperance streets, Toronto.

E. GOFF PENNY, R. Prefontaine, J. A. C. Madore, Montreal; N. A. Belcourt and F. McDougall, Ottawa, are applying for a Dominion charter as the Canadian Agricultural Utilization of Sewage Water Company, Ltd., having its chief place of business in Montreal, with a capital stock of fifty thousand dollars.

AN important students' organization came into existence at a recent meeting of the students of engineering at McGill University. It is the Applied Science Technical Society of McGill University. The special importance of the organization is that it will unite together not only the students at college but the graduates of the faculty.

D. McGillivray, Fort Steele, B C., has received the contract for the bridge work on the Crow's Nest Pass Railway from Crow's Nest Lake to Moyie Lake, 200 miles.

Goldie & McCulloch, Galt, Ont., shipped recently six carloads of sawmill machinery, including six boilers, for the Crow's Nest Pass Railway Construction companies.

A company will build a charcoal iron smelter in Deseronto, Ont., on condition that the Rathbun Co. take 25 per cent. of the output, and that the town gives a bonus of $25,000.

An acetylene gas generator exploded in a house in Oshawa recently, doing damage. The machine was blown to pieces, the top being blown upward, making a hole through the ceiling.

The molders at the Waterloo Manufacturing Co.'s foundry have gone out on strike, there being a difference between the manager and the molders regarding what the latter considered a fair day's pay.

The Tisdale property, Brantford, Ont., which has been vacant for several years, will be occupied by the Chalcroft Screw Company, which will be engaged in the manufacture of screws, nuts and bolts.

J. Stuart, foundryman, St. Catharines, Ont., recently cast what is said to be the largest bevel gear ever cast in one piece in Canada. It will weigh four tons; the gear will be used in the Riordon Paper Mills.

At the annual meeting of the Hamilton Iron Mining Company, John Milne was re-elected president, and the old board of directors was also re-elected. The company declared a dividend of 6 per cent. on the year's business.

The New Glasgow Steel Works may go to South Bar, C.B. It is stated that the Dominion Coal Co. are favorable to the erection of the works there, and that they are offering the Victoria pier at a very small sum, and free coal for a certain time.

The Goold, Shapley & Muir Company, Brantford, Ont., who recently had their factory destroyed by fire, have decided to stay in Brantford. The city council has given them the old Verity building for twenty years at a nominal rental of one dollar per year.

Robert Brick, who has been in charge of the tool-making department of the Canada Screw Works, Hamilton, for about a year and a-half, has gone to Vancouver, where he has secured a good position with the Automatic Can Company.

The Portland Rolling Mills Company, Limited, at the annual meeting elected the following board of directors, viz.; J. C. Robertson, president; S. Hayward, vice-president; James Mowat, sec.-treas.; Joseph A. Likely, W. H. Murray, and George F. Baird.

The Bushnell Oil Company are bringing in the machinery of their Petrolia, Ont, refinery to Sarnia. The Petrolia premises will hereafter be used only as a receiving station. The Bushnell Company is having a large number of underground tanks put down on its property in Sarnia.

J. Allison, W. H. Murray, T. McAvity, G. F. Baird, G. S. Cushing, G. McKean and James Fleming, Saint John, N.B., are applying for a New Brunswick charter as the Cushing Sulphite Fibre Company, Limited, chief place of business, Fairville, N.B; capital, $50,000.

St Thomas is to have a brass foundry, which will be established by the Messrs. Jewett, fonndrymen, of Buffalo, N.Y., who have made arrangements to supply the Michigan Central, the Wabash and the Grand Trunk Railways with all the brass fittings they require, and will also do a general business.

At a recent meeting of the Quebec Bridge Company, Mayor Parent reported that the statutory capital of the company, $200,000, was now more than fully subscribed, that the borings in the bed of the river were progressing satisfactorily and the bridge plans had been approved by the chief departmental engineer at Ottawa.

Vincent & Dufresne, civil engineers, St. James Street, Montreal, have a contract for a light portable dredging plant, to be equipped with engines to be run by acetylene gas. Builders of generators for this gas, and makers of suitable engines, should communicate with above firm at once. The experiment will be an interesting one, and the results will be carefully watched for.

The seekers after the treasure buried at Oak Island, N.S., are making progress. They are now sinking a shaft to be used as a pumping shaft, and when a depth of 180 feet is reached they will set up pumps and drive a tunnel toward the drain that leads into the "money pit" from the shore and takes the water out by way of the new pit. While sinking this pit they were doing some prospecting with a drill, and struck iron at 125 ft., 126 ft., 152 ft., 165 ft. and 170 ft. At the 153 feet depth they went through an oak box full of metal of some kind and brought up from it a small piece of parchment. This box is bedded in a cement analyzed and found to be composed of lime and sand.

J. R. Booth, Ottawa, will build a 300 barrel flour mill in Ottawa.

A. Gagnon, Victoriaville, Que., is adding one of the Jenckes Machine Co.'s standard boilers to his equipment.

The Dominion Paper Co, Kingsey Falls, Que., is setting up a new wet machine, one of the Jenckes Machine Co.'s standard 72-inch wet presses, shipped them a week or two ago.

A F. Bury Austin, Montreal, has secured the contract to supply all the dimension timber, white pine and hemlock, for both the understructure and bridge flooring of the new interprovincial bridge at Ottawa.

Joseph Guilbert, of Windsor Mills, Que., is making extensive additions to his saw mill, and has placed an order with the Jenckes Machine Co., Sherbrooke, for a large quantity of shafting, log-handling apparatus, etc.

W. W. Lee Chance, architect, Hamilton, Ont., has prepared plans for a steel frame canning and evaporating building for J. W. Van Dyke, Grimsby, Ont. The building will be 45 x 160 ft., without columns, and two stories high.

Incorporation has been granted to W. C. Fox, T. H. Graham, E. Buffum, F. G. Bowers, D. G. Lorsch, H. B. Latimer and J. R. Shaw, Toronto, as the Frontenac Lead Mining and Smelting Company, Limited; capital, $55,000.

The correspondence system of education in technical subjects, as carried on by the International Correspondence Schools, of Scranton, Pa., is one of the most successful plans ever devised for giving thorough, practical education to wage earners.

The Jenckes Machine Co., Sherbrooke, Que., is furnishing the Canadian Rand Drill Co. with a handsome compound Corliss air compressor weighing some 33 tons, together with accompanying apparatus, bringing the total weight nearly up to 40 tons.

Steps are being taken by T. L. Willson, president of the Calcium Carbide Company, to enter an appeal against the judgment of Magistrate Hall, convicting his men of a breach of the Lord's Day Act in the recent trial for working on Sunday, as mentioned in our last issue.

City Engineer Barrow, of Hamilton, has recently made some interesting experiments in sewage filtration on the lines laid down in different numbers of The Canadian Engineer. One of his experiments which was very successful was made with slack coal as a filtrate.

William McVicar, McVicar, Ont., is putting in a Dake Steam Feed, built by the Jenckes Machine Co., Sherbrooke, Que., with whom the Phelps Machine Co., of Eastman, Que., formerly Canadian manufacturers of the Dake engine, has amalgamated.

The Dominion Radiator Co. is being incorporated to take over the business of the Toronto Radiator Manufacturing Co.; capital, $300,000; directors are as follows:—Jos. Wright, D. Carlyle, J. Stark, J. M. Taylor and C. T. Stark, Toronto.

Incorporation has been granted to the Tree Rotary Engine Company, of Woodstock, Limited, to manufacture and sell Tree's Rotary Engine, and, for the said purpose, to acquire Dominion of Canada letters patent number 55,616 and number 56,806; capital, $24,000.

The waterworks system of Barrie, Ont., has been valued for arbitration purposes by E. Vanier, C.E., Montreal, at about $110,000, and by Willis Chipman, C.E., at $53,770; and E. H. Keating, C.E., Toronto, at $52,369. These figures are the estimated cost, less the speculative depreciation in seven years.

Galt, Ont., manufacturers are enlarging their establishments this year. The Goldie-McCulloch Co. is erecting new offices and intends to add to its present molding shop. The R. McDougall Co. Limited, is also contemplating extensive improvements to its foundry, and the C. Turnbull Co. will put up a mill on the site of the W. S. McKay factory.

The Royal Paper Mills Co. has recently added a complete rope drive to the transmission machinery at the East Angus, Que., mill. This was furnished by the Jenckes Machine Co., Sherbrooke, which is furnishing the entire tank work, together with the accompanying machinery. East Angus presents a scene of great activity, carload after carload of material arriving and being placed in position. When completed, this mill will take a prominent place among the producers in the pulp and paper trade.

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THE PUBLISHERS.

WILLIS CHIPMAN, C.E., has made a report to the London, Ont., city council, favoring the establishment of a sewage farm instead of running the sewage into the river as at present.

CITY ENGINEER MITCHELL, of Niagara Falls, Ont., has made a survey of the Niagara River bank both at the top of the cliff and the water's edge between the cantilever bridge and the whirlpool, for the park commissioners, who are preparing preliminary surveys of the water power facilities at the rapids.

Railway Matters.

F. B. WADE, Bridgewater, N.S., is applying for a charter to build a railway from Shelburne to Halifax.

THE Pennsylvania Steel Co., Harrisburg, Pa., will build sixteen bridges for the Grand Trunk this summer.

THE plans have been prepared for the new C.P.R. shops at Revelstoke, to which place the shops at Donald will be removed.

THE C.P.R. will build a new depot at Vancouver, B.C. This with wharves and other buildings, entail $300,000 expenditure.

ALEXANDER MCGREGOR has been sent out by the Dominion Atlantic Railway Company of London, Eng., to act as superintendent at Yarmouth, N.S.

F. R. F. BROWN, mechanical superintendent of the Intercolonial Railway, has been removed from his position and will, it is understood, open an office in Montreal as a consulting engineer.

THE Canadian Pacific Railway has done such a large grain business from St. John, N.B , this season that it has been decided to build another elevator there, and the plans are being got ready for a new one, which will be of 800,000 bushels capacity.

DR. KING, vice-president, and Superintendent Woollat, of the Lake Erie and Detroit River Railway, have made a trip over the proposed extension of the L. E. & D. R. R. from Ridgetown to St. Thomas, Ont. The latter town will probably give a bonus of $20,000 to the extension.

THE Canada Atlantic Railway Company is applying for power to construct an extension from some point on the line of the company on or near the River Richelieu, in the county of Missisquoi, in an easterly direction to a point on the international boundary line in the county of Missisquoi, or in the counties of Brome, Stanstead or Compton, so as to form a connection with the railway systems of the United States, and also from some point on present line near the St. Lawrence River or north-westerly therefrom, through the counties of Soulanges and Vaudreuil, crossing the Ottawa River near the Village of St. Anne, and to some point in the City of Montreal, by the most feasible route to the St. Lawrence River, at some point in or below the said city.

THE report of the Grand Trunk shows the net revenue surplus for the half year ending December to be £275,263, being an increase of £236,117 over the corresponding period last year. Passenger earnings decreased £151,728, compared with 1896. The tons of freight and live stock have increased 410,960. The earnings per train mile have increased fourteen cents, and the working expenses have decreased nearly seven per cent. The Chicago and Grand Trunk shows a deficit of £49.467, being £17.900 better than in 1896. The Detroit and Grand Haven shows an increase in net revenue of £21,373, leaving a net deficit of £2,174 on revenue charges. The directors report the agreement granting the Wabash Company joint use for 21 years of that portion of the Grand Trunk between Windsor and Black Rock station.

THE Governor of Newfoundland, Sir Herbert Murray, has signed a railway contract with R. G. Reid of Montreal. The Government claims that the arrangement will effect a saving of $80,000 a year in addition to promoting the development of the country. Mr. Reid has contracted to build a railway across the island and to work the entire railway system of 650 miles for 50 years. receiving a subsidy of 2,500 acres of land per mile. He pays $1,000,000 now, which will become $7,000,000 at the end of the period, when the colony takes the money and the contractors will take the railway. If he should make default in carrying out the contract during the period, both the money and the railway are forfeited to the colony. Mr. Reid purchases St. John's dock for $350,000, and the Government telegraph lines for $125,000. He also undertakes to build seven mail steamers to ply in the Great Bays, receiving a subsidy of $100,000 for thirty years. The contractor secures also certain coal areas which he agrees to work, as also pulp and lumber mills and copper and other minerals, being protected by a dollar duty to be imposed on imported coal. Furthermore he contracts to build an electric railway in St. John's, and tc pave the main streets of the city for $140,000.

THE management of the Grand Trunk Railway system has contracted with the Pullman Company, Chicago, for the construction of twenty first-class passenger coaches. They will be turned out with every modern improvement. The Grand Trunk is just finishing the construction of two hundred freight cars, and have decided to build three hundred coal cars in their Canadian shops. In addition, ten new locomotives have been received from the Baldwin Works, and ten more are coming from the Schenectady Works. The C.P.R. is also making the addition of some fifty-five cars to the already large supply used by the great Canadian trans-continental line. Ten of them will be sleeping cars, twenty of them first-class passenger coaches, ten tourist cars and five baggage cars. All, except the tourist cars, are being built at the company's shops, Niagara Falls, Ont., the Crossen Works at Cobourg having the contract for the tourist cars.

MOVING TIME!! Subscribers are reminded to notify us of any change in address necessary. Give both old and new addresses.

THE PUBLISHERS.

Electric Flashes.

W. MOORE & SONS have renewed their lighting contract with Meaford, Ont.

THE Perth, Ont., Waterworks Co. is installing two phase "S.K.C." motors.

THE Montreal Street Railway Co. has received an order for 20 motor cars from Kingston, Jamaica.

C. FRASER has succeeded Electrician Brown in office at the H., G. & B. power-house, at Stoney Creek, Ont.

ARKONA is said to be willing to give a $10,000 bonus to the proposed electric railway from London to Lake Huron.

PETERBOROUGH, ONT., is discussing a bonus of $1,000 a year for 20 years for a radial railway taking in the lake district.

HENRY MORGAN & Co., Montreal, have placed an order with the Royal Electric Co. for a 20 K.W. direct current generator.

THE Brantford, Ont., Electric and Operating Co. is installing a 60 K.W. " S.K.C. and a 40-light T-H Arc machine received from the Royal Electric Co.

IT is reported that the Quebec Electric Street Railway will extend its line from the city to Cap Rouge via the St. Louis road, and returning by the St. Foye road.

ARRANGEMENTS have been completed by which the extension of the lines of the Montreal Street Railway into the village of Verdun, are assured for the coming summer.

OWING to ill-health, John McDermott, who has been in charge of the Almonte Electric Light Company since it was formed, has retired from active work.

NEGOTIATIONS have been commenced with a view to construct an electric railway between L'Epiphanie and Joliette, Que., passing through the parish of St. Jacques de L'Achigan.

THE projectors of the Hamilton, Chedoke & Ancaster Radial Electric Railway, propose to extend it to Brantford, and are vigorously pressing the matter with the municipalities most concerned.

W. J. FLETCHER, Markham, Ont., proprietor of the electric light plant there which was recently destroyed by fire, has decided to reconstruct the plant, and has purchased from the Royal Electric Co. a 20 K W. " S.K.C." generator.

LAST year the Galt, Preston and Hespeler Railway carried 221,647 passengers, an increase of 2,027. The total freight carried was 12,973 tons, an increase of 4,663 tons. The increased earnings was $1,900. President Todd has been re-elected.

THE C.P.R. management is experimenting with a system of electric light generated from the axles of moving cars, and the results are said to be very promising. Storage batteries are used. · The " Winchester " is the first with the new electric system.

THE long-standing litigation over the assessment of the poles, wires and tracks of the Toronto Railway Company has been settled by the Court of Appeal giving judgment in favor of the city of Toronto. By the decision, the assessment of $452,277 against the company in Wards two to six is confirmed for 1898, which will probably yield between $7,000 and $8,000 in taxes.

TORONTO and Hamilton, Ont., are both agitating the question of municipal lighting plants. Tenders will, probably, be called for in each case; but only in order to determine prices for purposes of argument.

THE Shipton Electric Light and Power Co., Danville, Que., has received a Crocker Turbine from the Jenckes Machine Co., Sherbrooke, which is proceeding with the installation of the same with penstock and draft tube.

THE report of the U.S. commissioner of patents for the year 1897 shows that to residents of foreign countries the number of patents issued were: England, 706; Canada, 286; Germany, 551, and France, 222. The most noted are those connected with the development of electrical inventions.

T. E. MCLELAN, the courteous and obliging manager of the Berlin and Waterloo, Ont., Street Railway, has resigned his position to go to the Klondyke. He will be succeeded by H. H. Hilborn, E.E., of Montreal, who, since his graduation from Cornell, has been in the service of the Montreal Street Railway Co.

THE Halifax Electric Tramway Company, Limited, has just installed two large generators, each having a capacity of 6,000 sixteen-candle power lamps, which, together with generators previously operating, make the capacity of the company 18,000 sixteen-candle power lamps. There is no ground, the company states, for the rumor of the amalgamation of the company with the People's Heat and Light Company.

THE transfer of the Quebec District Railway from the present company to the new one formed by H. J. Beemer, will take place before July 1st. New open cars for summer use have been already ordered. Meanwhile the changing of the steam system to electricity on the line of the Quebec, Montmorency and Charlevoix Railway will be proceeded with. Most of the cars now in use upon the road will be run as electric cars with one, two or three trailers, as necessity may arise. It is the intention to run electric trains to Ste. Anne about every hour. About the whole amount of the capital stock of the new Quebec Electric Railway Company has been underwritten.

Personal.

MORGAN BALDWIN, harbor master, Toronto, died last month at his residence in that city.

THEO. ZWICKER, machinist, has now charge of the machine shop at the Halifax dry dock.

S. S. FOLEY, Chapleau, Ont., has been appointed despatcher on the Crow's Nest Pass Railway.

ED. S. FRASER, C.E., New Glasgow, N.S., has taken a position on the staff of the South Shore Railway.

JAS. W. MILNE, formerly of the Waterous Engine Works Co., Brantford, Ont., has gone to Vancouver, where he will represent a Montreal firm.

ENGINEER HUTCHINSON of the G.T.R., who was badly burned in the railway accident at Burlington, Ont.. died at the Hamilton Hospital, March 4th.

ARCHITECT ADAMS, of the Kingston Penitentiary, has been suspended from duty on a charge of insubordination preferred by Deputy Warden O'Leary.

H. GARDNER SMITH, the new engineer of the D.A.R. steamer "Prince Edward," has arrived at Yarmouth, N.S., from England and entered upon his duties.

R. G. MCCONNELL, of the Dominion Geological Survey, has accepted the position of mineralogist of the Province of British Columbia, to succeed W. A. Carlyle, who resigned.

THE death occurred at Truro, N.S., last month, of Wm. Yould, sr., assistant trackmaster of the I.C.R., aged 78 years. He was the first foreman of tracklaying on the Nova Scotia Railway, now a part of the I.C.R.

RAOUL RINFRET, C.E., of Montreal, who is going to the Yukon with the Slavin-Boyle party, has been commissioned by Minister Sifton to organize a meteorological service in the Yukon country, as well as to make certain surveys for the Interior Department.

THE well-known contractor, John Ross, died very suddenly at Lancaster, Ont., March 12th. He was very successful as a railway contractor, and very wealthy. It is said of him that he built more miles of railway than any other contractor in America. He was 78 years of age.

ALBERT ROBINSON, formerly of Crowe's Iron Works, Guelph, Ont., and lately of Detroit, has been made foreman of the Cossitt Works, Brockville, Ont.

JOHN GALBRAITH died recently in Brantford, Ont., from blood poisoning. Deceased had been employed for the past ten years as boiler-maker at the Waterous engine works. A few weeks ago he got his foot badly bruised with a heavy piece of iron, from the effects of which blood poisoning set in.

JAMES M. MACOUN, who has interested himself in the Behring Sea investigation for some years, has, in recognition of his services been appointed by the Government assistant naturalist of the Geological Survey. He has been on the temporary staff of the Geological Survey since 1883.

THE death of W. M. Hamilton, recently, removes an old resident of Toronto. Mr. Hamilton had been for the last year manager of the St. Lawrence Foundry, but from 1885 to 1893 he was superintendent of the Parkdale Waterworks Department, but resigned when it was amalgamated with the city.

SIR HENRY BESSEMER, the celebrated inventor of Bessemer steel, died in London, March 15th. Deceased was an eminent engineer, born in Hertfordshire, England, in 1813, he early devoted himself to the improvement of machinery, and acquired celebrity by his invention of a new practical process for the manufacture of steel, which was extensively adopted in Europe and America, and the product of which is known in trade as Bessemer steel.

CECIL B. SMITH, Ma.E., A.M., Mem. Can. S.C.E., who has just resigned his post at McGill, to take a position on the engineering staff of the C.P.R., was born at Winona, near Hamilton, March, 1865, and received his education at the Hamilton Collegiate Institute, and afterwards in civil engineering at McGill University, graduating in 1884 with first honors and the Governor-General's medal. Since that time he has been engaged chiefly on railroads, although working for a short time under Mr. Thomas Monro on the Welland Canal, and under Mr. John Kennedy on the Montreal Harbor Commission. He has had charge of many heavy pieces of construction; on the Northern and Pacific Junction Railway under Mr. J. C. Bailey, on the St. Catharines and Niagara Central Railway under Mr. B. N. Molesworth, on the C.P.R. at London, Ont., under Mr. W. T. Jennings; surveyed for the Toronto, Hamilton and Buffalo Railway during the summer of 1889, under Mr. A. L. Hogg. He was then appointed successively: resident engineer, chief draughtsman and division engineer on the C.C. and C.R.R. in Tennessee and S.C. under Mr. A. N. Molesworth, constructing 70 miles in all. He was then appointed division engineer on the Roanoke and Southern Railway, under Mr. Andrew Onderdonk, in charge of 65 miles of heavy work, including track-laying and maintenance. On this being completed, after short reconaissances for the Concord Southern Railway, he was appointed resident engineer on the Baltimore and Ohio Railway, under Mr. W. T. Manning, in charge of 14 miles of very heavy work. On completion, he was appointed Lecturer in Civil Engineering and Descriptive Geometry at McGill University, the duties of the former being to lecture in railway engineering and on testing of materials of construction. In 1888 he was made associate M.C.S.C.E., and in 1894 obtained the degree of Master of Engineering from McGill University. On the occasion of his resignation from the faculty of applied science, McGill University, Professor Smith was the recipient of a beautifully engraved walnut case containing two very valuable aneroid barometers, with kindest expressions of regard and regrets at his withdrawal from the university, on behalf of the undergraduates of 1898 and 1899 of the faculty of applied science. The interesting series of papers from Mr. Smith's pen which have appeared in the CANADIAN ENGINEER during the past year will be continued in next year's volume. The articles which have already appeared are now ready to be issued in book form as "Railway Engineering," Vol. I.

Marine News.

Edwardsburg Starch Co., Cardinal, Ont.: Steamer—Rosedale, Capt. Jas. Ewart, Engineer E. O'Dell.

Myles' Sons, Thomas, Hamilton, Ont.: Steamer—Myles. Capt. John S. Moore, Engineer Jas. Smeaton.

Sylvester Bros., Toronto, Ont.: Steamer—Eurydice, Capt. J. Jackson, Engineer Alex. Munro. Schooner—St. Louis, Capt. Geo. Williamson.

Merchants' Line, G. E. Jacques & Co., Montreal: Propellers—Cuba, Capt. Robert Chestnut, Engineer Wm. Kennedy; Melbourne, Capt. Hy. Chestnut, Engineer, Thos. Milne.

J. B. Miller, Toronto, Ont.; Steamer—Seguin; Capt. J. B. Symes; Engineer, Samuel Gillespie.

Fairgrieve & Co., J. B., Hamilton, Ont.: Steamer—Arabian, Capt. Oliver Patenaude, Engineer Alex. H. Bertram.

Conlon, J. & T., Thorold, Ont.: Steamer—Erin, Capt. P. Sullivan, Engineer J. Dawson. Schooners—F. L. Danforth, Capt. John Cornwall; Maggie, Capt. John Rosie.

North-West Transportation Co., Sarnia, Ont.: Steamers —Monarch, Capt. E. Robertson, Engineer E. W. McKean; United Empire, Capt. John McNab, Engineer S. Brisbin.

Lake Ontario & Bay of Quinte Steamboat Co., Kingston, Ont.: Steamers—North King, Capt. John Jarrell, Engineer O. J. Hickey; Hero, Capt. Wm. Bloomfield, Engineer John McEwan.

Canadian Pacific Steamship Co., Owen Sound, Ont.: Steamers—Manitoba, Capt. E. B. Anderson, Engineer R. Chalmers; Alberta, Capt. J. McAllister, Engineer A. Cameron; Athabasca, Capt. G. McDougall, Engineer W. Lockerbie.

McKay, R. O. & A. B., Hamilton, Ont.: Steamers—Sir S. L. Tilley, Capt. Geo. Mackey, Engineer Jas. H. Brown; Lake Michigan, Capt. Wm. O. Zealand, Engineer Jos. Boulanger. Schooner—T. R. Merritt, Capt. Wm. A. Corson.

Niagara Navigation Co., Jno. Foy, Manager, Toronto, Ont.: Steamers—Chippewa, Capt. J. McGiffin; Engineer, R. McCaul; Corona, Capt. W. H. Solmes, Engineer I. Walsh; Chicora. Capt. R. Clapp, Engineer H. Parker; Ongiara, Capt. R. McIntyre.

Matthews Line, Toronto, Ont.: Steamers—Niagara, Master, James Morgan; Engineer Thomas Mills. Clinton, Master, John Joyce; Engineer, Jno. Gray. Barges—Lisgar, Master, John Fahey. Grimsby, Master, S. Atkinson. Schooner—Clara Youell, Master, N. J. Colwill.

North Shore Nav. Co., Collingwood, Ont.: Steamers—City of Collingwood, Capt. W. J. Bassett, Engineer, Chas. Robertson; City of Midland, Capt. F. X. Lafrance, Engineer Wm. Whipps; City of Parry Sound, Capt. Ernest Walton, Engineer J. L. Smith; City of Toronto, Capt. A. C. Cameron, Engineer David McQuade; City of London, Capt. Geo. Dunn, Engineer C. Wilber.

The Toronto Ferry Co., Toronto, Ont.: Steamers—Primrose, Master, Chas. Tufford; Engineer Harry Brownley; Mayflower, Master, George Moulton; Engineer, Edward Abbey; Shamrock, Master, Thomas Jennings; Engineer D. Foley; Thistle, Master, Alex. Martin; Engineer, M. Murphy; Kathleen, Master, John Fertile; Soland Queen, Master, Joe Tymon; Engineer Thos. Good; Luella, Master, M. Corcoran; Engineer John Smiley.

Playfair Barge & Tug Line, Midland, Ont.: Steamer—St. Andrew, Capt. W. H. Featherstonehaugh, Engineer John McRae. Tugs—Magnolia, Capt. R. H. Gilberston, Engineer E. A. House; Metamora, Capt. Jas. Tyndal, Engineer George Smith; Minitaga, Capt. Ed. Burke, Engineer, Jno. Sinnott.

St. Lawrence & Chicago Steam Navigation Co., J. H. G. Hagarty, Mgr., Toronto, Ont.: Steamer—Algonquin, Capt. Jas. McMauger, Engineer, Jas. H. Ellis.

The Ottawa River Navigation Co.: Steamer—Sovereign, Capt. H. W. Shepherd, Commodore; Purser, D. M. Robertson; Pilot, Joseph Dufour; Mate, Joseph Bertrand; Steward, Alex. Sleeth; Engineer, Jos. F. Marchand. Steamer Empress—Capt., Alex. Bowie; Purser, W. A. Dorion; Pilot, John Galbraith; Mate, Alex. Arsen; Engineer, Geo. Menish. Steamer Duchess of York—Captain, John McGowan, jr.; Pilot, Pierre Sauvé; Engineer, Alex. St. Laurent. Steamer Princess—Captain, Peter McGowan; Purser, John Kelley; Pilot, Hormidas Rabeau; Engineer, Ferd. Piche. Steamer Maude—Captain, E. Gauthier; Purser, A. S. McIntyre; Pilot, D. Dupuis; Engineer, Narcisse Fugere.

Calvin & Co., Garden Island, Ont.: Steamers—D. D. Calvin, Capt. A. Malone, Engineer T. C. Smith; Bothnia, Capt. Geo. Brian, Engineer R. Veech; Armenia, Capt. Chas. Coons, Engineer Geo. Hazlett; Chieftain, Capt. John Sullivan, Engineer Thos. Gray; Parthia, Capt. David Lefavre, Engineer Geo. Sauve; Johnston, Capt. D. Lefavre, jr., Engineer, Ed. Phelix; Bluebell, Capt. John Dix, Engineer Fred. Lefavre; Reginald, Capt. John Doyle, Engineer John Kennedy. Schooners—Ceylon, Capt. H. Smith; Augustus, Capt. Jos. Achee; Valencia, Capt. John Ferguson; Norway, Capt. John Harris.

The following are the officers of the Richelieu & Ontario Navigation Co.'s fleet, so far as appointed to date of publication: Algerian—Capt. A. Dunlop; 1st Engineer, Thos. Wadsworth. Berthier—Capt. C. Gouin; 1st Engineer, D. Laviolette. Bohemian—Capt. J. McGrath. Canada—Capt. Thomas Dugal; 1st Engineer, G. Lefebvre. Carolina—Capt. Reverin; 1st Engineer, L. Latulippe. Columbian—Capt. G. Batten. Corsican—Capt. Esford; 1st Engineer, Jno. Parker. Cultivateur—Capt. Raymond. Hamilton—Capt. Baker; 1st Engineer Geo. Marshall; Hochelaga—Capt. Mandeville; 1st Engineer A. Chapullon. Hosannah—Capt. Mongeau; 1st Engineer, H. Gendron. La Prairie—Capt. Peter McLean. Longueuil—Capt. Jodiona; 1st Engineer Boncage. Montreal—Captain not appointed; 1st Engineer F. X. Hamelin. Mouche-a-Feu—Captain not appointed; 1st Engineer P. Bouchet. Passport—Capt. McDonald; 1st Engineer W. Taylor. Quebec—Capt. L. O. Boucher; 1st Engineer J. B. Gendron. Spartan—Capt. H. P. Granger. Terrebonne—Capt. E. Gouin; 1st Engineer M. Sheridan. Three Rivers—Capt. F. St. Louis; 1st Engineer, F. Gendron.

Montreal Transportation Co., Kingston, Ont.: Steamers—Glengarry, Capt. Gordon Kean; Engineer, John Evans; Bannockburn, Capt. John Irving, Engineer R. Taylor; Rosemount, Capt, J. W. Mawdesley, Engineer H. Thurston; Active, Capt. Edward Bennett, Engineer, John Hamilton; Bronson, Capt. Jos. Murray, Engineer R. Hepburn; Glide, Capt. Thomas Murphy, Engineer, Geo. Tuttle; Jessie Hall, Capt. C. Martin, Engineer Alex. Barton; J. A. Walker, Capt. John Boyd, Engineer Geo. Boyd; D. G. Thomson, Capt. Jas. Murray, Engineer G. Henderson. Lake barges—Kildonan, Capt. Maxime Lefebvre; Minnedosa, Capt. R. C. Irwin; Selkirk, Capt. H. Colvin; Winnipeg, Capt. James Kirkwood; Melrose, Capt. James Fleming; Dunmore, Capt. John Phillips. River barges—Alberta, Capt. Frank Poirier; Acadia, Capt. Louis Hebert; Bella, Capt. Peter Lalonde; Cleveland, Capt. J. D. Parron; Chicago, Capt. Arsene Charlebois, sr.; Colborne, Capt. Ben. Sauvie; Corn Crib, Capt. A. Charlebois, jr.; Cornwall, Capt. H. Boyer; Detroit, Capt. Treffle Davust; Dorchester, Capt. Jules Lalonde; Eagle, Capt. A. Monnette, Jr.; Hector, Capt. Tim Hebert; Glengarry, Capt. Albert Major; Harvest, Capt. John Bradley, Jr.; Iowa, Capt. Jos. Davust; Jennie, Capt. Moise Moreau; John Gaskin, Capt. Theo. Leduc; Lancaster, Capt. Jos. Page; McCarthy, Capt. E. R. Roy; Montreal, Capt. M. Lefebvre; Maggie, Capt. A. Monnette; Nebraska, Capt. Celestia Leboeuf; Regina, Capt. Ovide Trudell; Senator, Capt. Alfred Lalonde; Star, Capt. E. Secotte; Toledo, Capt. Fred Leduc; Toronto, Capt. A. Levoie; Wheat Bin, Capt. A. St. Marcelles; Cobourg, Capt. Frank Lafrance; Brighton, Capt. N. Mallette; Kingston, Capt. Alex. Hebert.

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MINERAL PRODUCTION OF CANADA.

The following summary of the mineral production of Canada in 1897 has been issued by the Geological Survey Department, and is subject to revision in a later bulletin :

Product.	Quantity. (a)	Value (a)
METALLIC.		
Copper (fine, in ore, etc.) (b) ....lbs.	13,300,802	1,501,660
Gold	.....	6,190,000
Iron ore ....tons.	71,451	178,716
Lead (fine, in ore, etc.) (c) ....lbs.	39,018,219	1,396,853
Mercury .... "	688	324
Nickel (fine, in ore, etc.) (d) .... "	3,997,647	1,399,176
Platinum	.....	6,600
Silver (fine, in ore, etc.) (e) ....ozs.	5,558,446	3,322 905
Total metallic	.....	13,996,234
NON-METALLIC.		
Asbestos and asbestic ....tons.	25,262	324,700
Chromite .... "	2,637	32,474
Coal .... "	3,876,201	7,286,257
Coke (f) .... "	78,811	209,920
Felspar .... "	1,275	3,506
Fire clay .... "	1,923	5,759
*Grindstones .... "	.....	40,000
Gypsum .... "	239,691	244,531
*Limestone for flux .... "	.....	40,000
*Mica	.....	75,000
Mineral pigments—		
Baryta....tons.	571	3,060
Ochres .... "	3,905	23,560
*Mineral water ....galls.	.....	140,000
Molding sand....tons.	5,485	10,931
Natural gas (g)	.....	325,873
Petroleum (h)....bbls.	709,857	1,011,546
Phosphate (apatite) ....tons.	908	3,984
Pyrites .... "	38.910	116,730
*Salt .... "	.....	190,000
Sundry minerals, partly estimated, including actinolite, graphite, manganese, soapstone and tripolite	.....	10,000
STRUCTURAL MATERIALS AND CLAY PRODUCTS.		
Cement, natural ....bbls.	85,450	65,893
" Portland .... "	119,763	209,380
Flagstones	.....	7,190
*Granite	.....	75,000
*Pottery	.....	125,000
Sewer pipe	.....	164,250
Slate	.....	42,800
Terra-cotta	.....	155,595
Building material, including bricks, building stone, lime, sands and gravels and tiles (estimated as for previous year)	.....	3,600,000
Total structural materials and clay products....	.....	4,445,108
All other non-metallic	.....	10,097,831
Total non-metallic....	.....	$14,542,939
Total metallic....	.....	13,996,234
Estimated value of mineral products not returned	.....	250,000
1897, Total....	.....	$28,789,173
1896 "	.....	22,609,825
1895 "	.....	20,715,319
1894 "	.....	19,933,857
1893 "	.....	20,035,082
1892 "	.....	16 628,417
1891 "	.....	18,976,616
1890 "	.....	16,763,353
1889 "	.....	14,013,913
1888 "	.....	12 479,550
1887 "	.....	11,365,705
1886 "	.....	10,221,255

*Partly estimated.

(a) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(b) Copper contents of ore, matte, etc., at 11.29 cents per lb.

(c) Lead contents of ores, etc., at 3.58 cents per lb.

(d) Nickel contents of ore, matte, etc., at 35 cents per lb.

(e) Silver contents of ore at 59.79 cents per oz.

(f) Oven coke, all the production of Nova Scotia and British Columbia.

(g) Gross return from sale of gas.

(h) Calculated from inspection returns at 100 galls. crude to 42 refined oil, and computed at $1.42½ per bbl. of 35 imp. galls. The barrel of refined oil is assumed to contain 42 imp. galls.

The following table shows the principal changes in production and values for the calendar year 1897, as compared with the figures given in the revised summary for 1896 :

PRODUCT.	Quantity. Increase. p.c.	Quantity. Decrease. p.c.	Value. Increase. p.c.	Value. Decrease. p.c.
Metallic—				
Copper	41·6	.....	46·9	.....
Gold	.....	.....	122·6	.....
Iron ore	.....	22·3	.....	6·7
Lead	61·2	.....	93·7	.....
Nickel	17·7	.....	17·7	.....
Silver	73·4	.....	54·6	.....
Non-Metallic—				
Asbestos and asbestic	106·2	.....	.....	24·5
Coal	3·5	.....	0·8	.....
Gypsum	15·8	.....	37·3	.....
Natural gas....	.....	.....	17·9	.....
Petroleum	.....	2·3	.....	12·5
Cement	37·6	.....	36·5	.....

The increase in the items silver and lead is practically all to be credited to British Columbia, to which province is also largely due the increase in the production of copper. The largest increase in this latter metal is, however, due to the increased shipments of nickel-copper mattes from the Sudbury mines in Ontario. The third copper producing province, Quebec, also contributed a fair amount to the increase shown. The silver, copper and lead increases as far as British Columbia is concerned, represent the largely extended activities in the South Kootenay districts of Slocan, Nelson and Trail Creek.

The most significant item, however, is to be found in the increase of nearly 123 per cent. in the gold. All the gold producing districts of the Dominion show gratifying increases, although by far the largest part is due to the discoveries of rich placer mines in the Yukon country, and to the increased output of Trail Creek and other districts in British Columbia. The former increase amounted to about 2¼ millions and the latter to nearly $1,000,000.

The remaining metal of importance is nickel, which is seen to have shown an increase of nearly 18 per cent. As in the past this is all from the Sudbury district.

Thus the aggregate result of the increases in the metallic productions is nearly $6,000,000, or a proportion of about 74 per cent.

An interesting result of the mining developments and discovery of 1897 is shown in the increase in the proportion of the value of the total mineral production to be credited to the metals. In 1896 these constituted about 36 per cent., whilst in 1897 this proportion was increased to nearly 49 per cent.

Turning to the non-metallic products, we find that as far as the data at present available permit of a conclusion being arrived at, the total value shows under 2 per cent. of an increase over that of the previous year. The only considerable change to be noted is that given under the heading asbestos, where the quantity has more than doubled, whilst the value has fallen off almost 25 per cent. This is due to the fact that the output of the new by-product, asbestic, is included. This constitutes over half the weight of the whole, but being a low-priced article brings down the price per unit very much. The returns, however, show also a falling off in the prices of the usual grades of the mineral apart from the above influence.

In the important mineral coal the variation is but little. The falling off in the production of the higher priced mineral of British Columbia and the increase in that of Nova Scotia at a lower price causing a fall in the total value. In gypsum the increase in the value is larger than that shown in the quantity. This is due to the larger proportion of the higher priced product, plaster of Paris, included in the returns for 1897. The lower average price ruling during that year for petroleum caused the decrease in the value of this article to be much greater than in the quantity.

The following table gives the proportional values of the different minerals in the grand total. It is interesting to note the changes in their relative position in 1897, as compared with 1896 :

Product.	1896. Per cent. of Total Production.	Product.	1897. Per cent. of Total Production.
Coal	31·94	Coal	25 31
Building material	15 72	Gold	21·50
Gold	12·30	Building material	12 50
Silver	9 50	Silver	11·54
Nickel	5 25	Copper	5·21
Petroleum	5 11	Nickel	4 86
Copper	4·52	Lead	4·85
Lead	3 20	Petroleum	3·51
Asbestos	1·90	Natural Gas	1 13
Natural Gas	1·22	Asbestos	1 13
Cement	·89	Cement	·95
Iron	·85	Gypsum	·84
Gypsum	·79	Coke	·73
Salt	·75	Salt	·66

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We quite agree with *Advertising Experience* on this point, having knowledge of more than one case in which results have come from advertisements many months after their appearance. Had advertisers judged of the merits of the medium from immediate results, the chances were decidedly against the paper.

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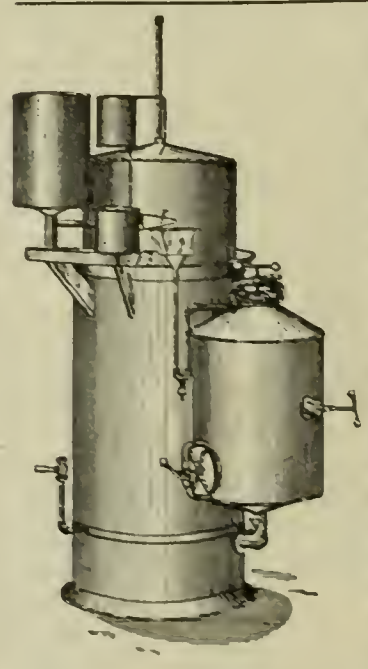

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FOR THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

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CHAPTER VI.

(Continued from last issue.)

RAILWAY LAW.

Railroads being recognized as public necessities have had great powers conferred on them by legislatures, which have also necessitated many legal restrictions to prevent the abuse of these powers. All of which in Canada has in time become formulated in the "Railway Act." This Act defines, amongst other things necessary for a railway engineer to be familiar with:—

I. The powers conferred on the Railway Committee of the Privy Council for negotiating traffic, tolls, returns, methods of operation, of construction, capital stock, and distribution of gross revenue obtained.

II. The privileges and powers granted to railway companies.

III. The duties of a railway company to the Government and to the Privy Council.

IV. The duties of the railway company to the individual, and the rights of the private individual.

Much of the matter contained is rarely needed by the engineer, and the following extracts cover the main information which he is likely to need in the course of construction and maintenance.

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

I.—POWERS CONFERRED ON THE RAILWAY COMMITTEE.

(*a*) To regulate the speed through various classes of cities, towns and villages—which is not to exceed six miles per hour in any case.

(*b*) To regulate the use of steam whistles in towns, cities, etc.

(*c*) To regulate the means for passing from one car to another, for the safety of employees, and the methods of coupling cars.

(*d*) To impose fines for offences under these clauses.

(*e*) To enquire into, hear and determine applications, disputes or complaints regarding right of way and location questions, constructing branch lines, the crossing of one railway company's tracks by those of another railway company, the construction of railways along or across highways or navigable waters, tolls, rates, running powers, traffic arrangements, unjust preferences, discontinuations, distortions and the carrying of highways, streets, ditches, sewers, etc., over or across the lands of a railway company.

(*f*) By itself or agents, it has full legal power to enter on to property of a railway company to examine books, plans, etc., to summon witnesses and in general it is to have the same powers as a law court.

(*g*) The inspecting engineers of the Privy Council are to have every desired information, in reason, supplied to them on demand. They are to be carried free while on inspection trips, and to have the services of all company telegraph operators free while on Government business—penalties for obstructions of the inspecting engineers are also defined.

II.—THE PRIVILEGES AND POWERS OF A RAILWAY COMPANY.

These are given with the view of assisting the company in overcoming obstructive measures, of a corporation or individual, where it is evident that the public would be best served by the construction and operation of a railway.

These powers should be thoroughly considered by a company's engineer before taking any steps likely to incur the ill-will of the public, to whom the company must ultimately look for its income.

(*a*) The company or its agent may enter on crown lands or the lands of any person or corporation whatever for the purpose of survey and location.

(*b*) It may purchase land for the use of the railway, and may sell what it does not need.

(*c*) It may build anywhere within one mile of the first located filed line, or within any further distance prescribed by the special Act.

(In the Act a railway is said to be near to another when some part of one is within one mile of some part of the other railway.)

(*d*) It may fell trees within 99 feet of either side of the railway, when they are liable to fall across the track.

(*e*) It may cross or join any other railway, and enter on its lands.

(*f*) It may divert temporarily or permanently streams, highways, water or gas pipes, sewers, drains or telegraph or telephone poles, but must restore them to their former

state, if possible, or put them in a state not materially altering their usefulness. (Note this with reference to keeping them open during the construction of the roadbed.)

(*g*) It may construct, operate and keep in repair its road, together with the accessories commonly belonging to a railway, and may carry traffic and collect tolls, and may, in general, do everything necessary to a successful operation of its enterprise and the accommodation of the public, but in the exercise of these or other powers the company shall do as little damage as possible, and make full compensation for damage done or loss inflicted, in a manner prescribed in the Railway or a special Act.

The essence of these general powers is compensation. It is the limitation of what would otherwise be absolute, arbitrary powers.

II. (*A*) Powers with Limitations.

(*a*) No person who holds a contract for work with a railway company can be a director on its board, nor can a director or officer of a company even go surety for a contractor.

(*b*) The first charges on the income of a railway company are the penalties, if any, arising from this Act. The next are the working expenses of the road, and the third are the bonds—the latter, however, all having equal claims in proportion to remaining assets.

(*c*) The consent of the Governors-in-Council is necessary before Crown or Indian lands can be entered on, and in the case of Crown lands the right of way only, i.e., an easement, is all that can be obtained, and not ownership or full possession.

(*d*) The consent and approval of the Railway Committee must be obtained before possession or use of the land or property of another railway company can be effected.

(*e*) The ordinary amount of land obtainable without the consent of the owner is 99 feet, while exceptions are authorized by the Minister in case of deep cuts or fills and depot grounds, which is in general limited to a tract of land 1,950 feet long by 300 feet wide, but any extent of land may be purchased with the consent of the owner. Extra land is to be shown on the maps or plans filed with the Government.

(*f*) After filing plans (to be afterwards explained) the company may take possession as shown on those plans, and settle afterwards, amicably or by arbitration. This is a very necessary power, for otherwise contractors would be kept off the land for indefinite periods, the progress of the work impeded and a good chance given the contractors for suits for damages caused by delay, or for excuses for slow progress.

(*g*) The company may enter on lands not more than 600 feet from the located line, for purposes of construction or repairs, without consent of the owner, provided a sum of money, fixed by a judge of the Superior Court, is deposited with that court, pending the award for damages.

(*h*) Power of surveying and arbitrating in the usual way is also given whenever the company desire extra land for stone, gravel, water or earth, or on which to construct sidings or branches, or on which to convey water to the company's works.

(*i*) The company may occupy land between 1st November and 1st April, with snow fences, subject always to damages as a court may decide.

(*j*) No lateral deviation of more than one mile shall be made from the original location, except under provisions of a special Act.

(*k*) Error in name or omission of the same from plans and books of reference does not prevent the company from entering on land so affected.

III. Duties of a Railway Company to the Government.

(*a*) On completion of location surveys, plans and books of reference showing all properties asked for, must be forwarded in triplicate to the Minister, who after ten days' notice to all interested parties, hears all counter claims and representations, and the plans, as finally decided on, are signed by the Minister, after which one copy is retained at the department, another is deposited by the company in the office of each municipality affected, while a third one is given into the hands of the company itself. After these proceedings following the action as described in Art. *f*, powers with limitations.

(*b*) All extra widths desired must be shown on the plans filed.

(*c*) Any change from the original plans or profiles must have separate plans, etc., submitted and deposited in the usual way before the alteration can be made.

(*d*) Ten days after plans have been filed in the offices of the municipalities (registry offices) and notice published in a newspaper, a notice may be served on interested parties owning land, giving

(*a*) Description of land required.

(*b*) Amount offered by the company for land or damages.

(*c*) Name of company's arbitrator if offer is not accepted.

Such notice to be accompanied by a sworn statement of a surveyor or engineer (not an arbitrator).

(*a*) That the land is needed as described for the purposes of the railway.

(*b*) That he knows the land, or damages likely to result, from the railway being built and operated.

(*c*) That the sum offered is, in his opinion, fair compensation.

(*e*) Should the offer not be accepted, arbitration is resorted to. This is usually outside the province of the engineer, except in giving evidence and preparing plans, but it may be useful to remember that, in considering the value of land taken or amount of damages done, the increase of values of lands adjacent (*i. e.*, of same plot) not taken by the company, which is created by the construction of the railway, is to be taken into account and offset against damage inflicted.

(*f*) Before a company can unite with or cross over any railway with its roadbed or track, it must submit plans and full details of proposed mode of crossing to the Railway Committee, and give ten days' notice of application to the other company affected. The committee may make such changes or regulations as appear necessary for public safety, and apportion the cost of constructing the necessary works to the different companies, and may also, in case of level crossings, on application of either company, direct such inter-locking signal system or device to be used as, in their opinion, renders it safe for engines to pass over such crossing without coming to a full stop. This clause also applies to electric and other street railways.

(*g*) When the railway is finished, plans and profiles in triplicate of the completed work, showing land taken, names of owners, etc., must be filed as in the original survey or alterations within six months after completion of railway, under penalty of $200 fine per month.

(*h*) The scales of plans and profiles are to be as prescribed by the Minister; they are usually: Plans, 400 feet to one inch; profiles, 400 feet to one inch horizontal: pro-

files, 20 feet to one inch vertical, and are to be all signed by the chief engineer or president of the railway.

(*i*) Within 48 hours at furthest, after any accident has occurred on a railway line, involving personal injury, or the damage or destruction of any structure, the railway company must notify the Minister of the same under $200 per day penalty. And, if necessary, the Privy Council may appoint a commissioner to enquire into the causes, etc., of the same.

(*j*) Annual returns from 1st July to 1st July must be forwarded in duplicate to the Minister within three months after the expiration of such financial year by each railway company, of its capital, traffic, working expenditure, and any other information shown on the blank forms furnished.

(*k*) Weekly returns of traffic shall also be furnished the Government within one month after the period quoted, and a copy of the same must be posted for public view in the head office of the company.

(*l*) Twice a year accidents and casualties must be similarly reported within one month after each six months' period has elapsed, giving, (1) Causes and natures, (2) locality and time of day, (3) extent and particulars.

IV. GENERAL DUTIES OF A RAILWAY COMPANY TO THE PEOPLE AND THE RIGHTS OF INDIVIDUALS.

(*a*) A company may not obstruct the entrance to a mine, open or about to be opened.

(*b*) A company shall not impede navigation in a navigable river.

(*c*) In constructing drawbridges, bridge-piers or wharves, the manner of construction as it affects navigable waters shall be fully and entirely decided upon and directed by the Railway Committee, under heavy penalties for disobedience.

(*d*) Highway crossings.

I. A railway shall not be carried along a highway, but shall merely cross it, unless permission has been obtained from the Railway Committee, and, in crossing a highway, a good safe passage for vehicles must be kept open continually and no obstruction offered to travel.

II. In a level crossing, the surface of the rail must not be more than one inch above or below the general surface of the crossing.

III. When a highway passes under a railway, it must have at least 20 feet clear width and 12 feet clear height, and the gradient of the highway shall not exceed one in twenty, unless originally greater and left undisturbed.

IV. When a highway passes over a railway, the approaches shall not have a gradient of more than one in twenty, and must be fenced at least four feet high, and the bridges by which these highways are carried over the railway shall have a clear height of seven feet above the highest freight car hauled over the road, and over 14 feet clear width shall be given on approaches and bridges.

V. The company shall present to the Railway Committee (which notifies the municipality interested that they may oppose by a delegation) a plan and profile of every proposed highway crossing, and the committee will then decide whether it is to be changed in any way, or if a level crossing is approved of, whether a gate and watchmen are necessary to public safety, and the decision of the committee regarding details of construction, and also as to apportionment of costs between the company and other parties interested, is to be final, and followed out within a prescribed time under penalty.

VI. Sign-boards with letters six inches high shall be placed at every highway level crossing.

(*e*) Farm crossings.

One, at least, shall be made for every separate portion of land and for each disconnected portion thereof, so located as to be difficult of access otherwise than by means of a crossing of the railway.

(*f*) Bridges and tunnels.

Shall be built, maintained (and raised if necessary, whenever repaired or reconstructed), so as to maintain a clear height of seven feet between the top of the highest freight car used and lowest beam or obstruction of the bridge or tunnel.

N. B.—The Governor-in Council may except from this clause any railway on which air brakes are used exclusively. No company shall run cars over any bridge unless constructed and maintained with safeguards, and of strength approved of by the Minister.

(*g*) Fences and cattle-guards.

Whenever municipalities are surveyed or settlement exists, fences and cattle-guards shall be built and maintained, and in case of adjacent land being occupied, this must be done as fast as rails are laid, and the company shall provide gates having proper fastenings or hurdles at all farm crossings. When this is done, it is the duty of the landowner to keep the gates closed when not in use. If left open accidentally, no action for damages against the company can be sustained, and if left open purposely, a counter-claim for damage may be entered in addition to inability of recovering for loss of animals, etc., resulting from such leaving open of gates, etc. (Fences must be turned in to the cattle-guards).

(*h*) Opening of the railway for traffic.

No company shall open its road for passenger traffic until one month after giving notice in writing to the Minister, and after an inspecting engineer sent by the Government shall have reported favorably as to the safety of the road, strength of structures, and adequacy of rolling stock.

(*i*) Repairs.

Upon complaint of the officers of any municipality, the Government shall send an inspecting engineer to examine the condition of the road, and the company shall at once make such repairs as he considers necessary for public safety. Until such repairs are made the engineer may limit the number, speed or weight of trains and engines passing the point under repair.

(*j*) No discrimination in tolls between different persons or companies for the same service shall be allowed; any special rate allowed to one must be allowed to all.

(*k*) No secret special rebate or toll shall be allowed, and any company shall on demand make known to any one any special rate, toll or rebate.

(*l*) No discrimination between places shall be allowed, unless a lesser rate is necessary to secure freight at a competing point. (This, therefore, protects local points only against one another, and not against railway centres.)

(*m*) Every company shall afford full and equal advantages to all persons wishing to ship or travel over their railway, and shall afford equal facilities to each and every connecting line or lines of railway for transfer of traffic.

(*n*) Every company affording facilities to any express company shall grant the same to any other express company demanding it.

(*o*) Every agent of the company shall receive freight or any allowable traffic when offered for shipment, under penalty.

(*p*) Every train before crossing a draw or swing bridge shall stop at least one minute to ascertain from the bridge tender that the bridge is closed and safe to cross.

(*q*) At least 80 rods before crossing every highway (on level) a bell must be rung or whistle sounded, and this

must be continued at short intervals until the crossing is passed.

(*r*) An officer shall be stationed at every level crossing of two railways, and no train shall pass over it until a signal has been made to the conductor that the way is clear.

(*s*) Every train shall stop one minute at a level railway crossing as in No. 16, unless there is an interlocking system, when they may pass at such speed as the committee may allow.

(*t*) No train shall pass through thickly populated towns, etc., at more than six miles per hour, unless the track is fenced.

(*u*) No train or car shall be allowed to stand on a highway crossing more than five minutes at a time.

(*v*) All frogs, wing rails, guard rails, etc., shall be packed up to the underside of the rail wherever less than five inches space exists.

(*w*) Sections (*p*), (*r*) and (*s*) have been recently modified so as to permit of interlocking signals being introduced at junctions and railway crossings, in which case the Privy Council may permit trains to pass in or across at specified rates of speed without stopping, whenever the signals give the right to do so, but if the signals are not satisfactorily worked the council may revoke the permission.

For THE CANADIAN ENGINEER.

THE VENTILATION OF PLUMBING APPLIANCES.

BY W. M. WATSON.

In a former article I showed some of the evils attached to the present method of ventilating traps at the highest points, and the danger of venting plumbing in any case. I have never been able to find out the reason why such a complicated and expensive system was invented, but have an impression that the inventor erroneously thought that there would always be an upward current from the breather pipe at the ground line to the terminating end of the soil pipe above the roof, and there certainly would be if the temperature of the atmosphere at both points were always equal, or if it were always colder above the roof than it is at the mouth of the breather near the ground line. But sometimes it is warmer, and in that case there will be a down in place of an up draught. If the purification of the interior of the house soil pipes was aimed at, then the object is often frustrated by the choking of the street line sewer trap, or by the breather getting filled with stones, dirt, or weeds, and even when every point of the house drainage is free, open, and working well, we find that by adopting the Chicago and Toronto rules we are sacrificing the greatest sanitary privilege adopted, viz., the ventilating of the street sewers above the house tops, for the insignificant purpose of securing a very small and doubtful advantage.

When the soil pipe is connected without the street line trap, direct to the crown of the main sewer, as shown in THE CANADIAN ENGINEER of April, 1897, there is nearly always an upward current from the drain to the head of the S.P., because the temperature in the main sewer will generally be higher than the atmosphere, and if any exception to the rule occurred, causing a down draught, the foul odor in the house soil pipes would be forced into sewer, instead of out of the breather, which is the case at present. Since the American system of plumbing was adopted in Toronto I have noticed some of the places where fever and diphtheria have occurred, and I believe that statistics will bear me out when I say that the street line trap and vent-pipe method of plumbing is doing considerable damage. It is hard to choose between the evils of the careless putty and paint plumbing of twenty years ago and the intricate plumbing demanded at the present time in Toronto.

When Dr. Norman Allen was the medical officer of Toronto I asked him if he considered it right to spoil the ventilation of the public sewers and injure private property by compelling each owner to put in a trap at the street line of the private drain? His answer was, "No," but he reminded me that the by-law was passed by the council, and again altered within a few months, and that if another change was made so soon it would put both his department and the council at a disadvantage, because the public would get alarmed and lose confidence. The fact that the present officers who apply the law in Toronto are in no hurry to give their own private property the benefit of the Toronto plumbing by-law, proves that we might place them also as unbelievers in the system.

It is necessary to keep polluted air moving, and the vent pipes will help to do this; but to get air to circulate naturally, it must have a continuous circuit, and if branches are inserted into the line, the draughts will be spoiled, exactly as with the draught of a stove, when the smoke pipe is inserted into a chimney flue where there is another stovepipe hole open. Taking this fact into consideration, it shows that as every house must have at least three vent pipes, and two of them are branched into one, or all three are branched into a receiver, which in turn is branched into the side of the soil pipe, it makes it impossible to secure a natural draught through any of the pipes, because no continuous circuit can be formed, and the conclusion must be that the only real value the vent pipes can be, is, that they do away with any pockets where air may lodge in the waste pipes, and will prevent any chance of syphoning of the traps.

There is evidently a strong feeling in certain quarters in favor of creating unnecessary business, increasing expenses, and securing a monopoly in favor of syndicates and wealthy tradesmen, to the exclusion of the small ones. When reading the by-laws of Toronto one cannot but see that the sanitary advantages are put in the shade by the points that call for high licenses, heavy bondsmen, useless piping, labor and joints. Great waste is obvious in many places. In one case we find a sink only intended to catch water from a garden tap placed in the cellar that has about 40 ft. of 1½ in. iron vent pipe running level under the ceiling joists until it is attached to the w.c. vent. Now the friction that will have to be overcome before any movement of air can take place in a 40 ft. length of so small a pipe laid horizontally, is more than enough to totally prevent any action, and of course such a pipe is perfectly useless. In some small cottages rented for about $4 per month, having a w.c. and soil pipe through the roof, and on the opposite side of the house a sink with about two feet of 1½ waste pipe and trap attached to a properly ventilated drain, as also a vent pipe taken from the knee of the trap and continued up to above the roof, with 3 in. iron soil-pipe, costing about $14 each house, which expenditure is of no value for sanitation purposes, and it injures the current of air in the drain, and assists to dry out the sink trap.

There are a number of large towns, with a dense population closely packed together, in Europe, whose sanitary rules are of such a nature, and so well applied, that with all the disadvantages of the majority of the people working in close, heated rooms, having the fumes from grease, soap, steam, etc., to inhale, the death rate is less

than either Toronto or Chicago. The mode of application of their sanitary rules is both simple and effective. Before property can have the privilege of water supply, the waterworks' rules must first be complied with; also before it can secure the advantage of a sewage outlet to the street sewer, the health and sanitary laws must be fully carried out, and if property is not supplied by these necessary requirements it cannot be inhabited. But no public body can interfere with the rights that have already been acquired, except by paying compensation, unless the property is or contains a public nuisance and is unfit for public habitation, and even in that case the courts of law are not often required, for if an owner declines to keep his sanitary and waterworks appliances in good order he will receive notice to have them corrected, and when the time given expires, and the request is not complied with, the public authorities send their own tradesmen to do the necessary repairs, and charge the cost in the tax bills. This can all be done without threatening letters or a dozen visits from inspectors, and at a cost of about one-tenth of what it cost Toronto, and also without dragging the respectable citizens and tradesmen into a criminal court, or scaring weak people with official letters. When engineers and inspectors are clothed with absolute authority, those tradesmen who are compelled to work under them might almost as well hand their business over to the fortunate official, or make special efforts to please him in some other way, for there can be a wide difference between an inspector being satisfied with the work done at two different places, and by two different firms. I have had a letter in my possession from a former engineer of Toronto, in answer to a plumber's complaint about an official who had been unreasonable, and demanded more than the law required, which stated that the inspector could not be wrong, and he must be obeyed or a summons would be issued. The complainant then applied to the mayor, and the council appointed a committee which never met or gave the plumber a hearing. This sort of management usually occurs where business is done in favor of or by the requests of syndicates and monopolists that have a strong financial backing.

All rules and regulations made for the government of the general public should be plain, clearly described, easy to understand and carry out in every detail, definite and pointed, and having illustrated diagrams and plans showing what is wanted. It is unfair and unjust to allow any single person or body of officials to have the power to harass a tradesman, so that his expenses are increased and business damaged, while another friendly business firm may evade the law, or its work be easily declared satisfactory, securing good profits. The best sanitary laws are so framed that the most ignorant mechanic cannot make an error or mistake that will in any way injure the public health, and every detail of the fitting inside the building can be observed at a glance.

For THE CANADIAN ENGINEER.

FOUNDATIONS.

BY CHARLES BAILLAIRGE.

Allow me through the medium of your journal to call the attention of Canadian architects to the very concise and lucid illustrated article on "Foundations," which appeared in your last issue. The writer says: "The foundation of a structure is much more important than any other feature of its design, as on its security depends that of the structure itself." Our Canadian architects, I am loath to say, have not of late years been up to the mark in respect to foundations. Hence so many failures of buildings, especially of country or parish churches in the Province of Quebec, and other places which I might name, where the foundation areas, not being proportioned to the weight to be supported, portions of the structure have settled down unequally, tearing themselves away from others in a disgraceful manner, or to the disgrace of all concerned. I noticed this at J——— some three or four years ago, where the whole front of the church had parted from the side or wing wall, and the salient tower from the remainder of the front, due to its still greater weight, it having sunk eleven inches below datum level, and entailed an expense of some $7,000 or more in reconstruction. Other churches, I am told, as at the St. C. and St. B., have had to be, due to distortion by unequal settlement, taken down and rebuilt in toto.

Now the question arises as to at whose door the fault of such failures is to be laid. I must unhesitatingly say that, generally speaking, the architect is or should be considered the responsible party, and I cannot in saying this be open to any suspicion of partiality towards contractors, being one once myself, having practised as such for over twenty years before entering on civic service, and am still doing so. The architect should in every case plan and specify his foundations in a way that, if so executed, they may be thoroughly reliable, and then in case of the parish, through assumed poverty or otherwise, refusing to put in such foundations, the architect should execute the work under protest, so as to clear himself thereafter and saddle the blame where it belongs. The contractor should act in a similar manner, refusing to build a building under protest both to the architect and to the proprietors or wardens, in case of an improperly and inadequately designed substructure.

If the contractor carry out a plan as specified, he cannot be blamed for any failure due to settlement, as he is not supposed to form the necessary technical knowledge to allow him to judge of insufficiency and the ability of the soil to do what is expected of it in the way of supporting the structure. But the architect is supposed to possess this knowledge, and if he does not he should acquire it, or he is no architect at all worthy of the name. It is deplorable now-a-days that the engineer has to be called in to help the architect through with his foundations, for of the two the architect is the one supposed to have the more difficult problems to deal with sometimes, as in providing against the strains and thrusts to which sidewalks, piers and pillars are subjected by arched roofs or ceilings and domes of masonry, while with the engineer all these strains are conjured into submissiveness by the homogeneity of a pinned together or riveted structure, every part of which is thus tied and bound in a way not to give. What would architects of old have done had they not known how to proportion their resistance to their thrusts? There were no engineers in those days as we have them now. To what engineer did Michael Angelo apply to tell him how stout to build his piers to stand the pressure of St. Peter's dome, to load the supporting soil with weights proportional to their breadth of base? To whom did Christopher Wren address himself to study out the stresses of St. Paul's?—to whom the respective architects of the Pantheon, the Pantheon of Paris? They would have been ashamed, humiliated, to have had to rely in such matters on anyone else's knowledge than their own. It must not be argued that it is not less infra. dig. for the engineer to call in the architect to ornament his structure, make it artistic and acceptable to the age, than for the architect to call in the engineer. No, the cases are entirely different. Art and

ornamentation are a branch of architecture, the other two of the three components being constructive and distributive. Then, since the architect must know construction, he should possess all the technical elements thereof, and be able to prepare his own strain sheets, precisely as the engineer does at the present time, the architectural features in the engineer's case being a mere adjunct, while in the architect's case they are an essential.

The written protests I refer to are, of course (and may be more or less disagreeable) unpalatable to some or all of the parties concerned. The architect and contractor both fear that they may thus estrange or rile the proprietors into calling some other architect or builder pliant enough to do the needful and run all risks. "ruat coelum," but the absolute necessity of such action on the part of both architect and contractor in case of foundations of doubtful efficiency, has been so often and disastrously illustrated by the many failures alluded to, and the cost of repairing and rebuilding, that it is to be hoped that proprietors themselves, parish or other authorities, will see the necessity and philosophy of such action on the part of the architects and builders, and it certainly is not fair to saddle the contractor with the cost of underpinning or rebuilding, when they, (the authorities) have from motives of economy decided on a cheap "platform" or "grillage" foundation, where a piled or down to rack structure should have been decided on from the beginning. And in buildings in general, too much reliance is placed on the supporting powers of the outer walls. It is too easily forgotten, and more frequently ignored, that while each of the outer walls bears only one-quarter of the weight, the central wall will have double duty to perform, and hence the fact that so many structures sag at the centre. Another thing of vital importance in the rigidity of a building, and the supporting power of its floor, is that as far as possible every joint should have three points of support, or that they be made to extend from end to end of the building, while supported at the centre, or where there are two intermediate walls, that each alternate joint be made to reach and to bear upon the wall or the opposite sides of the corridors. Where this is not done the floors sag disgracefully towards the centre, and the mere walking across them causes everything in the room to shake and tremble most disagreeably, as with a certain building erected in Quebec, where not from negligence or any consideration of economy, but from sheer ignorance on the part of the architect of the difference between the strength of a beam when secured at the ends and extending to other points of support, as compared with one bearing loosely at its extremities on the supporting beams. Look at the late London, Ont., disaster. Had the joint in this case been of a single stretch from wall to wall, their combined strength, even without the beam which broke, would have gone far towards supporting the weight of the crowd in the room where the collapse occurred, and at any rate their resisting powers added to those of the incriminated beam would have prevented the accident; but on the contrary, every one of the joints were in two length width, their ends meeting on the centre beam, hence the failure.

For THE CANADIAN ENGINEER.

ROAD MATERIALS AND CONSTRUCTION.

BY W. M. WATSON.

When making roads we have the privilege of copying the system of construction used by the makers of the old Roman roads, which are yet sound and firm, and the later methods used by Metcalf, Tilford and Macadam, who revived the Roman and Swedish process of road-making in a lighter and less expensive form. This country is rich with first-class materials, which only require to be intelligently put together to make good roads. Each old road-making sample shows us that every road and street must have its roadbed well drained. When making a new road the sod and small under brushwood should remain, if convenient, intact, because the rootlets make a tough foundation to build the stone bed on. In places where artificial banks have to be made to raise the level of the road, or when crossing bogs, marshes and soft places, a good thickness of pea straw or brushwood, etc., should be laid across on the soft material before commencing to build the stone foundation.

When the Romans set out a new road, they cut a trench along each side line at least one foot deeper than the bottom of the intended roadbed. These were filled with large boulders, or a rough drain was made, with outlets at short distances into some natural water course, which efficiently drew off all the water from the under side of the foundations. Macadam rounded his roads a little on the surface, the crown being at the centre, giving them a gentle fall to each side. He constructed his roads by laying down three, four, or more layers of stone about six inches thick, rolling each layer down even on the surface to the same shape and grade that the road would finish. He suited his material used to the nature of the ground and the traffic that would afterwards use the road, always placing the largest lumps at the bottom, and rubble varying from one inch down to one-quarter inch for the top course, having the whole rolled hard and tight together, but using no sand or soft material except water. Hard frost cannot hurt a road that has a dry foundation.

Short residential streets might be made to fall a little to a central channel only about one inch deeper than the road surface, placed vertically over the main street sewer, having iron storm water grids that would serve both the purpose of ventilating the sewer and drawing the water from the street. This methed does away with the nuisance of having costly trapped gullies, with large pockets filled with decayed matter, throwing off disagreeable odors, close to the sidewalks and the houses. It saves digging across the street to the gullies, besides the value of the branch lines of pipes from the centre sewer to the gullies. It allows the wagons to get close to the sidewalks, and gives a width of dry road during a rain storm and frosts near to the houses where it is most needed. It also prevents the traffic from passing over the main drain where the road is weakest. Then the roadbed and foundation falling to the centre can be easily made to drain itself into the main pipe sewer, and last, but not least, the side of the streets will not be so slippery as under the present system in frosty weather. This method of grading streets is by far the cheapest, and the pavement is more durable and healthier for our climate.

We now come to roads suitable for traffic in populous cities, requiring smooth surfaces, and we revive again the customs and road materials used by the old Babylonians, and of Egyptians. There are numerous kinds of materials manufactured for roads and sidewalks that will stand any kind of weather, and that may be got at a reasonable cost, wearing from 20 to 50 years, and always be neat in appearance and comfortable to the wearer during the whole of the material's lifetime.

For instance, where high temperature destructors are used to destroy the garbage, the residuum is a very hard burnt clinker and fine ash. C. & A. Musks, of Bootle, Eng., have invented a press and other machinery to manufacture the clinkers into concrete flags equal to stone, and

less liable to retain moisture, and I here give a report published of the manufactory at Liverpool, of slabs made from one-third cement and two-thirds clinker, and ash taken from the garbage destroyer.

COST OF MANUFACTURE OF ONE YARD OF CLINKER CONCRETE FLAGGING, 2½ INCHES THICK.

Materials.	Cost.	Remarks.
65 lbs. of Portland cement	10¾d.	Varies with cost of cement.
152 " of clinker.....	nil.	Really a saving of 1¾d.
Water	¼d.	This item could be dispensed with where pressure is obtained by using steam power of destructor.
Labor	5½d.	
Plant contingencies and supervision	3¼d.	
Total cost per yard	1s. 7¾d.	

The total cost of manufacture is thus about 1s. 7¾d per square yard, without reckoning the saving in using the clinkers. The sizes of the slabs that are made are 2 feet by 2 feet, 2½ feet by 2 feet, and 3 feet by 2 feet,. each being 2½ inches in thickness.

Some of these slabs have been laid twelve months and show no sign of wear. From the experience already gained, engineers believe that this class of flag will have a life as long, if not longer than stone, and owing to the porous material with which they are made, the clinker paving slabs have a foothold much better than the natural stone.

TESTS MADE AT LIVERPOOL OF MACHINE-MADE CLINKER CONCRETE FLAGS 2½ INCHES IN THICKNESS.

Age of flag.	Breaking load applied at centre of flag.	Age of flag.	Breaking load applied at centre of flag.
4 months	1,804 lbs.	6 months	2,061 lbs.
4 "	1,474 "	6 "	1,966 "
4 "	1,742 "	4 "	1,859 "
4 "	1,917 "	4 "	1,659 "
4 "	1,608 "	4 "	1,589 "
4 "	1,752 "		

Concrete sidewalks made from granite chips and cement are pleasant and safe to walk on for about eight months in the year, the balance they are very slippery and dangerous. Wood sidewalks are slippery in wet weather, unsanitary, and at all times unsuitable. So that something in the shape of slabs that can be taken up and again replaced, and that are not slippery, also having a smooth surface, seems to be in demand. In places where they use a suitable wood set on a well drained thick concrete foundation, for street pavements, its wearing power is almost equal to good stone, having the advantage of being noiseless and easy for horses' feet. The wood most in favor at the present time in Europe is Australian hard wood, the best being called karri and jarrah. See table of strength, etc., below, prepared by James P. Norrington, C.E., London, England:—

	Local Name.	Weight per cubic foot in lb.	Breaking stress in lb. per square inch.	Elasticity in lb. per square yard.
West Australia.	Karri	65·00	215·00	7,070·000
	Jarrah	56·00	171·00	2,940 000
New South Wales.	Ironbark	73·85	25·08	5.526 400
	Blackbutt	65·69	21·70	3,105 979
	Mahogany	75·06	19·75	3,741 376
	Tallow wood	72·06	16 16	2,274 790

Colonel Bell, United States Consul, at Sydney, strongly recommends his own countrymen to use the Australian hardwood for paving in place of their own lumber. A test made of wood pavements at Euston Road, London, Eng., by James P. Norrington, C.E., proved that at the end of three years, the wear of jarrah and karri was only ¼-inch, and with yellow deal, it was worn down 1⅜-inches. I suppose our Canadian light cedar blocks would have gone out of sight altogether. The same engineer gives the cost of pavement complete with one foot thick concrete foundation to be $3 per square yard.

For sidewalks, cement and brick are good wearing when properly made, having a dry foundation of broken clinkers or coarse gravel. Tar pavements are smooth, durable and noiseless when made with well seasoned material. The tar should be stored in a cistern for over six months before using, so that the volatile oils and moisture come to the top, and are removed, then mix the tar with clean, small broken stone, say from one to three eighths in size, heated to a high temperature, so that the stone will absorb the tar without ignition. The longer the material is mixed before being used, the better road it will make, say within two years. This kind of road can be freshened and repaired with boiling tar and sharp sand when defects occur.

The best and most durable roads are made of pure genuine asphalt scientifically mixed with suitable materials; but, unfortunately, this is seldom except on sample patches, and the adulterated article cracks, gives out, and rots away under vibrating traffic. Asphalt is found in several countries, the best quality and largest supply is at present at Trinidad.

Asphalt is black and brittle at an ordinary temperature; when broken, the fracture takes the shape of a shell; when two pieces are rubbed together, an agreeable odor is emitted, having no resemblance whatever to coal tar. Crude asphalt weighs 65 lbs. per cubic foot, and refuses to attract moisture. It becomes partially soluble in turpentine, ether, petroleum or naphtha. Almost from the creation of man, what is now called asphalt seems to have been known and used. Its use and value is now being increased. Asphalt pavement is a composition with pure refined asphalt as the basis, mixed with 68 parts of sharp sand, 15 of powdered limestone, and 17 of asphalt, all the portions heated to a high temperature, and mixed by machinery while hot, and afterwards stored in a dry place or carted in a covered wagon to the place needed, and laid down warm. When laid on a firm and strong concrete foundation, the road will wear well, and stand heavy traffic.

For THE CANADIAN ENGINEER.

FRICTION.

BY WILLIAM PERRY.

Friction is greatly influenced by the hardness or softness, smoothness or roughness of the surfaces rubbing against each other. It is in proportion to the pressure or load, that is, a double pressure will produce a double amount of friction, and so of any other proportionate increase of the load. The friction does not depend upon the extent of surface, the weight of the body remaining the same. The friction is greater after the bodies have been allowed to remain at rest for some time in contact with each other, than when they are first so placed; as, for example, a wheel turning upon gudgeons will require a greater weight to start it after remaining some hours at rest than it would at first. The cause of this appears to be that the minute asperities, which exist even upon the smoothest bodies, gradually sink into the opposite spaces, and thus hold upon each other; it is for the same reason that a greater force is required to set a body in motion than to keep it in motion. If about one-third the amount of a weight be required to move that weight along in the first instance, one fourth will suffice to keep it in motion. The friction of axles does not at all depend upon their velocity; thus, a railroad car traveling at the rate of 20

miles an hour, will not have been retarded by friction more than another which travels only 10 miles in that time; it appears, therefore, that the amount of friction is as the pressure directly without regard to surface, time or velocity. Friction is greatly diminished by unguent, and this diminution is as the nature of the unguents, without reference to the substance moving over them. The kind of unguent which ought to be employed, depends principally upon the load; it ought to suffice, just to prevent the bodies from coming into contact with each other. The lighter the weight, therefore, the finer and more fluid the unguent should be.

As regards friction in water pipe, it does not matter whether the water is flowing down or up hill, or whether the pressure is light or heavy, or in long conical and smooth pipes, or whether it is flowing to or from the small end. The total friction will be the same in one or both directions in the first case, and the same in both directions in the last case. In the conical pipe, however, the friction per unit of length or per lineal foot will be less than the average at the large end of the cone, and more than the average at the small end. The total frictional head will be the same as though the whole pipe had a uniform diameter, just equal to the diameter in the conical pipe at the point where the friction is equal to the average for the whole length. I wish it to be understood that when I speak of friction in water pipe, I mean literally what I say —resistance encountered within the pipe by the water, friction in water pipe, not of water pipe. The velocity and resistance vary in different size pipe. If in a section of water pipe we take two points 100 feet apart, and find that with a given number of gallons flowing per minute, the actual pressure in the first instance is 100 pounds, and in the latter 99, we figure that the sum of the resistance in that length of pipe is one pound, or the loss by friction is one pound. If we go another 100 feet we get but 98 pounds, or the friction loss will be two pounds, and the ratio of loss will extend for miles in length. If the number of gallons flowing in the pipe is doubled, still keeping the pressure at 100 pounds at the first point, we shall get about 96 pounds at the second and about 92 at the third point, and we find by doubling the velocity of the flow, we increased the friction loss four times. It is surprising to note the great increase of loss from friction in small over large pipe, discharging equal quantities of water.

Discharging Pipe.	Gallons per minute.	Velocity in feet per second.	Friction in pounds
2½ inches	300	19.6	23.06
3 "	300	13.6	11.2
4 "	300	7.66	2.66
6 "	300	3.40	0.37
6 "	1,000	11.3	3 88
8 "	1,000	6.38	0.94
12 "	2,250	6.38	0.63

In the face of all such facts, towns and villages will use small pipe. I could mention quite a number of towns to-day with a water supply only fit for household service, and crippled in case of fire.

The internal surface of fire hose in a number of cases adds to the loss of pressure by friction to a much greater degree than is generally supposed. The writer's interest in this matter has grown from a desire to obtain better and more reliable information on these very important points. Installing quite a number of fire protection plants in the Dominion has enabled me to go very fully into the matter of friction in hose and pipe; in canvas hose there is a loss of from 25 to 50 per cent., rubber hose from 10 to 30 per cent. Yet from time to time you will see some new-fangled coupling introduced. I came across one some time ago arranged as a cone; the idea of the inventor was no doubt to prevent blowing out from the hose. It was 2⅛ x 2⅜ in. inside, and intended for fire department 2½ hose. With a test on ordinary rubber hose there was a friction loss of 38 pounds, and with the ordinary 2½ coupling under the same pressure 18 pounds on the same hose. Quite a number of such are on the market. All contractions in couplings, projecting washers, automatic cut-off valves, are very detrimental to the efficiency of flow of water, and are first-class friction producers.

CANADIAN NICKEL.

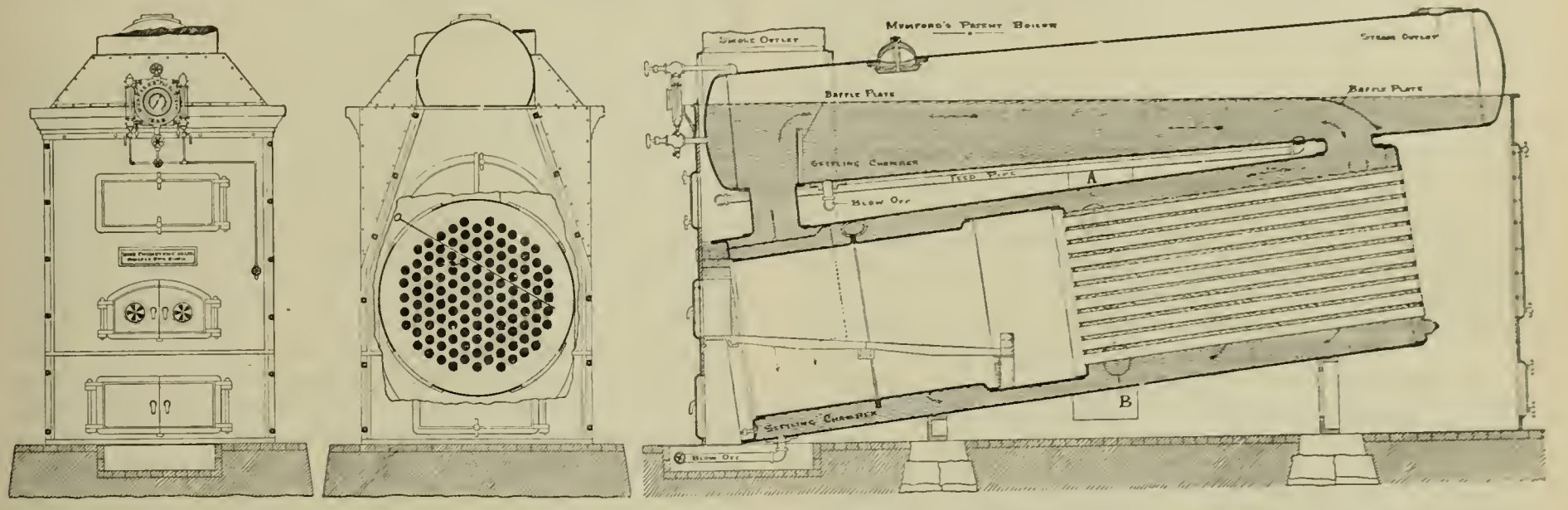
There is nickel ore in Ontario and New Caledonia, a French possession in the Southern Pacific, which can be profitably placed on the market. The market is world wide, for nickel has been decreed by the leading metallurgists to be necessary to the naval construction of the future, and the demand for warships is limited only by the credit of the nations or the endurance of their taxpayers. The copper bearing Ontario nickel ore is the more profitable, and its competition, although the development has been slight as yet, is said to have almost ruined the French company. Would not these facts lead us to expect to find a great industry in Ontario mining, smelting and refining nickel? Instead of that we have the Canadian Copper Co., whose mines, its manager, R. M. Thompson, stated before a committee of the United States Congress, "are owned entirely by Americans, and in treating whose ores they use American coke." He also stated that the $28,000 per month which the company was obliged to spend in Canada is made up for by the expenditure of $100,000 per month in the United States.* "The Canadian Copper Company is a United States corporation chartered by the Ohio Legislature, in which is only one little stockholder in Canada, holding perhaps one hundred or two hundred shares of the company," stated the president, Stevenson Burke, before the same Congressional Committee. The question now before the Dominion Parliament is whether Canada should not in her own interests place an export duty upon the ore and also upon the nickel matte, which is the product of the smelting process, heavy enough to render it necessary for the company to erect refineries in Canada and give Canadian labor the benefit of the working of Canadian ore. The boards of trade in various leading cities and towns have endorsed this proposal. The sentiment of the public generally seems to be that Canada should have reasonable use and profit of her resources, and that export duties seem the most feasible way of securing it.

It was rather a curious circumstance that at the meeting of the Federated Canadian Mining Institute held in Montreal some little time ago, so determined an effort was made by some of the members to secure an expression of opinion which might be used in the service of this alien corporation. It is certain surely that no stockholder of the company was present because it was a meeting of Canadians, and we have the president's statement that the members of the Canadian Copper Co. are all citizens of the United States, with one exception, and it is hardly likely that out of Canada's millions of people, that one man was present. We are credibly informed that the Canadian Copper Co. paid a ten per cent. dividend last year and carried a comfortable sum to the rest account. We hope the Canadian nickel company may soon do the same.

*See Sixth Report Ontario Bureau of Mines.

MUMFORD'S IMPROVED BOILER.

On this page we illustrate a new boiler intended to meet the demand for greater economy and efficiency than are obtained from the ordinary brickset boiler. The water circulation is similar to that of a water tube boiler, and for very high pressure it is built with a corrugated furnace. It was designed by J. A. Mumford, and is manufactured in Canada by the Robb Engineering Co., of Amherst, N.S., and in the United States by a large concern in Erie, Pa. The furnace has ample room for mixing the gases, and is surrounded by water so that the direct and radiant heat of the fire is readily absorbed. The heated gases pass directly through well-proportioned tubes, and return around the shell of the boiler and underneath the drum; thus, it is claimed, making every square foot of the boiler effective as heating surface, and enter the smoke stack with sufficient temperature remaining to produce good natural draft. By covering the case and drum with a non-conducting material the loss of heat is reduced to a minimum. The water circulates continuously from the front to the back of the boiler, up the back connection to the drum, where the steam freely separates from the water, and down the front connection to a point below the fire. This positive circulation admits of using forced draught, increasing the horse-power of the boiler without foaming or priming, the increased temperature increasing the speed of the water circulation, the makers claim, without any evil effects.



Special arrangements are made to avoid trouble with bad water. The feed pipe enters the drum near the back end, and part of the sediment is deposited in a settling chamber at the front end of drum and may be blown out. Additional impurities that are carried down the front connection are deposited in another settling chamber below the furnace. This leaves very little, if any, impurity to form scale on the furnace and tubes, and it may be removed by a scraper inserted through hand holes in the shell, the tubes being spaced so that all can be cleaned. Doors are placed in the casing opposite these hand holes which also give facilities for cleaning the outside of the shell. The Robb Engineering Co. inform us that they have already installed two of these boilers in Montreal, and others in Lethbridge, N.W.T., Fort William, Ont. and Parrsboro, N.S., while a number more are ordered.

THE NAVIGATION OF THE AIR.

Editor CANADIAN ENGINEER:

In your issue for November I notice an article on "The Navigation of the Air," by C. Baillairge, C.E., and thinking some of your less scientific readers might be left in the dark through the nature of his article, I am led to make a few remarks, in the hope that they may somewhat clear the obsurity as to the principle, method and nature of the most successful attempt at aerial navigation in the last few years.

In the article Mr. Baillairge says, "that there never has been an attempt (at imitation), as with flying machines, to imitate in the balloon the shape of a bird on the wing;" and then again he says, "there must be (imitation), to be successful in directing them" (balloons). Now here we have a man trying to advocate an old and exploded theory, that of navigating the air with a machine that is itself many times lighter than the element in which it floats. Not on, remember, as in the case of the ship, which case he tries to parallel with that of the balloon, and says, "as man has become (successful) in propelling vessels through the water, by building them in imitation of the fish." Here we see what similarity exists between a fish and a modern steamship, such as the "Lucania," as ships, I believe, move partly through and partly over the water, whereas the fish moves entirely beneath and through that element. Now as to the propelling power, with reference to that of the fish, again we fail to see the similarity between the two. The fish propels itself by its tail, using its fins as auxiliary motors; but in the steamship, where is the mechanism representing the tail or the fins of the fish? It is true you will find the respective motors in the same relative position, but the resemblance between them I think is very slight. One being an oscillating movement of a fan-shaped appendix, the other a rotary motion of a blade screw. So that we see that the supposed likeness, referred to by Mr. Baillairge, does not really exist.

Then he continues: "Nor will flying-machines ever prove a success until some closer imitation has been arrived at, than heretofore, of the winged denizens of the air." Now, to take some other problems that have been solved by our inventors and mechanical engineers, not in the way suggested, by adhering strictly to Nature's models, but by radical departure in some instances. Firstly, had we imitated the ox or the horse and made the machine which draws our trains to-day, walk on legs, instead of roll on wheels, we undoubtedly would not have had trains whisking us through space at 60 and 112½ miles per hour. Secondly, had our marine architects imitated the fish and his oscillating tail we would not have had a "Campania" or "Lucania" crossing the Atlantic in less than six days, or a torpedo boat rushing through the water at 37¾ miles an hour.

Then is not a flying machine proper, the "aerodrome," a nearer imitation to nature's model than the "soaring machine," advocated by Mr. Baillairge, which is merely what is known as a "steerable balloon," slightly modified? I think so, inasmuch as it is vastly heavier than the air, which fact is true of nature's various models. Then again, he continues, with reference to the relative buoyancy of the balloon against that of the air-ship, "thus, as it is, the balloon is buoyant, but without the proper shape to render it possible to direct its motion, while the 'sky-flyer'—this we interpret to mean air ship, though we never have heard the term used before—is deficient in the opposite sense of having the power of direction without the buoyancy." We doubt if the latter part of the above statement will stand investigation, for surely had the author made the slightest pretence at ærodynamics or æronautics he would have known that the flat or concave surface of any considerable extent (not being prohibitively heavy) when held rigidly at an angle of from 3° to 8°, and moved rapidly forward in a horizontal line, does not need any buoyance outside of itself to retain it in space, its own onward movement being sufficient. That this is the true principle of air navigation has been proved by Langly, Maxim and others. And we may say here without going further, that our inability to steer balloons is not on account of their shape but on account of their weight, or more correctly speaking, the absence of the above property. Had a balloon got the weight, still retaining its floating qualities, there would be little difficulty found in directing its motion.

A little further on Mr. B. tells us to "try to conciliate or combine the two requirements or desiderata."—that of the balloon and air-ship—the two he says must be blended. Believing him to be an advocate of the rule, that "nature must know best," and that in experiments nature's models should be followed as closely as possible, his argument here seems not a little inconsistent. Here we would ask him, if instituting a compartment filled with gas in his flying machine or bird-like structure is imitating nature's model? and if so, in what part of the bird's anatomy the balloon-like structure is located? Further on continues the author, "there is another cause which helps the bird to soar on air" (the first cause mentioned was the bird spreading its wings and extending its tail so as to underlap them, thus forming a kind of æroplane) "this is the very heat generated by the bird's body." Then he asserts that the heat generated by the bird rarifies the air contained in the cavity between the wings. Now, to the generality of us this statement is rather confusing, for heretofore, we were not aware that any cavity existed between the wings, though there may be something of that nature beneath them, it is generally believed that between the wings is located the birds body. As for the air being rarified by the heat of the bird's body and imparted to the cavity or concaved surface of the underside of the wing, thus having

a tendency to lift still further or at least retain in space, we think this factor too insignificant to be reckoned with, as figuring out on a scientific basis will prove. In the next paragraph, the writer asserts that "the soaring of the birds of prey is due to their flesh-eating propensities, which creates in the blood a vast amount of carbon, and when brought in contact with the oxygen of the air, in rapid respiration, sets fire to the interior. Now here we have the bird of prey making a veritable furnace out of its stomach by its own action, and the heat generated thereby being used balloon-like, to help maintain its position in space. Then he says with reference to the soaring faculty of the bird, no other explanation can be offered save the one he adduces. Surely this is a sweeping assertion. He then makes reference further on to the "ball-cock" or nozzle mystery, of which he says he gave the first explanation; here again we think he is not quite correct, but he does not give data to his explanation. He states that "increased buoyancy might be obtained under a flying-machine or parachute." Here in particular, as all through his article, he seems to be mixing matters by using such terms as "balloon," "flying-machine," "air-ship," "sky-flyer," "ærostat," "imitative bird," "æroplane," and parachute," some we think peculiar to himself, but most of them universal terms used to designate a particular style of machine for navigating the air, but in this article they all seem to relate to his peculiar machine, whatever he intends to name it, and to the mind of the average reader renders his article rather obscure. Surely it must be a singular looking object that could be called literally a flying-machine or parachute. Then going further with the matter of buoyancy it is asserted that by causing a jet of steam, or a jet of gas or atmospheric air to issue from ball-nozzles or concentric cones, so as to come in contact with the concaved roof of the flyer, and by the mere effect of the friction, suck the air from the funnel-like space enclosed by the jet, thereby forming a vacuum within, and in this way producing buoyancy sufficient to float the flyer, the overplus power of the buoying contrivance to be applied in propelling the "bird-like structure" through the air. Here I would ask the author if he has ever got down to facts and calculated the power and weight of engines or motors of other kinds necessary to compress air or produce steam sufficient to supply ball-nozzle or concentric cone of the number necessary to lift a given weight say of 500 lbs., less the weight of engines (which is not a prohibitive weight, I think, for a practical "sky-flyer") or the area of ceiling or roof for the cones or nozzles to play upon, We think not, or he would have seen that the idea was too absurd to even dwell upon for a moment. But as the writer penned the foregoing statements he seems to have been reflecting, for in the next paragraph he says: "But better still, let the buoyancy be provided for in advance of starting by making the structure a balloon or space-enclosing one." Then he proposes to steer his balloon or soaring machine—for such it really is—by making the propeller shafts capable of separate action, and alternately increasing or decreasing one or the other's speed, in order to keep the balloon on her true horizontal course. How he is going to alter his balloon's vertical course or altitude he does not state, but we presume that this must be brought about by the escape of gas or ballast. With the method of steering suggested above it strikes us that quite a complement of engineers would be required, some one of them at all times would have to be perpetually working throttle, reversing lever, governors or electric switchboard, etc., etc. Here again the writer seems to have reflected on his preconceived method of steering, for in the next sentence he says, "and if the aerostat were provided with a rudder." Again as in other places throughout the article his second thought is infinitely better than the first. At the next bound the reader and his thought of air-ships is landed head over ears among astronomy and astromers, which having nothing in common with æronautics we will pass over without further comment.

And now to conclude with the suggestion to the writer, that if he has such implicit faith and confidence, and believes the principle of his machine to be the only and ideal air-ship of the future, the best method of proving whether his ideas are correct or not would be to have one built on a practical scale and make or attempt to make a flight with it. The danger of such a course is made all too apparent by the history of Dr. Woelfert and his balloon, "Duetschland," which caused the death of the doctor and his assistant, Herr Knobe, on the 12th of May last, at Berlin. This balloon embodied many of the features of the "sky-flyer." For practical matters on æronautic and ærodynamics, I would refer Mr. Baillairge to articles by H. S Maxim, S. P. Langely, Lilienthal and M. Tatin, also Æronautical Annual, 1896-7.

GORDON M LOCKHART, M.E.

Winnipeg, Man.

The Waterloo and Hespeler Electric Railway wants $40,000 from Berlin and Waterloo, Ont., to extend their line to these towns.

For THE CANADIAN ENGINEER.

THE SWEDISH IRON AND STEEL INDUSTRY AS SHOWN AT THE STOCKHOLM EXPOSITION.*

BY ERNST A. SJOSTEDT, M.E., MONTREAL

Sweden has for centuries been so well known as a mining and iron producing country that it was expected to have something very interesting in this line to show the world at the Stockholm Exhibition last summer. But even to the most expectant and partial a genuine treat was here in store. For in a most picturesque neighborhood of the beautiful Swedish capital we found the varied products of the country brought together—not in a more or less haphazard manner, but of the choicest only, and this most tastefully and systematically arranged and displayed. The iron industry especially showed a remarkable life and activity; and the more we studied the different exhibits the more we must marvel at the truly wonderful material shown, the like of which has not been produced elsewhere in the world. In fact, such toughness and strength combined with such remarkable softness and pliability as the best grades of the Swedish iron possesses cannot even be approached by other nations, and its tool steel armor plates and projectiles stand highest in the world's market. Compared with any of the great iron-producing countries, Sweden occupies but an insignificant place, for while Great Britain and United States each produced about 8,600,000 tons of pig iron in 1896, and Germany 6,400,000 tons, Sweden can boast of only 545,000 net tons. But what here lacks in quantity is amply made up for in quality, as we soon will see.

In what a healthy condition the Swedish iron mines are, and of what superior purity the ores used at the Swedish furnaces, can be gathered from the following data:—The total number of (net) tons of iron ore raised in 1896 was 2,245,980, as compared with 1,088,120 tons in 1891. The principal producing districts and representative mines are:

	Net tons.
(1) Grangesberg (Dalarne), with an output of	704,000
(2) Gellivara, Luossavaara and Kurunavaara.....	660,000
(3) Norberg (Westmanland), about	171,000
(4) Dannemora (Upland) "	60,000
(5) Striberg (Nerke) "	44,000
(6) Persberg (Vermland) "	30,000

Of these, the Grangesberg and Gellivara ores are rich in iron (57 to 68 and 60 to 68 per cent. respectively), but high in phosphorus (.05 to 1.25 and .08 to 84 per cent.), and for this reason cannot be used in the Swedish blast furnaces where quality is aimed at, but are exported, the former principally to Germany and Austria where they are used in the basic (Thomas and Gilchrist) processes, and the latter to England, Germany, Belgium and France. All the other representative ores are exceptionally low in phosphorus—from .001 to .03 per cent.—and also in sulphur—from .01 to .05 per cent.—except the Dannemora "pyrite ores" with about 1.25 per cent. sulphur; which, however, are so thoroughly roasted that they do not contain more than .02 to .05 per cent. sulphur when being ready to use in the blast furnace. Upon these two points, the very possibility of the present active condition of the Swedish iron trade rests. And the practice of the great corporations holding the purest ore mines never to sell or export any of their ores, but keeping them for consumption at such works only in which they are interested, gives them practically a monopoly of the best pig iron and steel billet trade, and enables them to obtain a price for their product, in and out of Sweden, that would make an American ironmaster feel quite envious, although he may not be disposed to take all the numerous small precautions used here, which, however, are indispensable for obtaining such results.

As most of the iron ores are magnetites (in 1896 87.4 per cent. of the whole production was magnetites, and 12 6 per cent. red hematites), and as the red ores often are so mixed with the magnetic ores that they also are attracted by the magnets, the simple miner's compass has of old been quite an important factor in the discovery and tracing of the Swedish iron ores. During the last 20 to 25 years, however, the more complicated, but also much more accurate and scientific instruments designed by Prof. Thalen† and Mr. Tiberg‡ have come in quite common use. Together with the mining maps, models of the mines are generally made of a series of horizontal and parallel glass plates, on which the sections are drawn in clearly defined colors, representing the different minerals and rocks encountered. These models are without doubt both neat and instructive, and the idea well worth imitating at every mine, as it shows at a glance all the shafts, levels and work-

*Abstract from a series of articles written for *The Iron Age* while at the Exposition.

† Thalen's Magnetometer, described by the writer in the Journal of the U.S. Association of Charcoal Workers, Vol. VIII., p. 262.

‡ Tiberg's Magnetic Inclination Balance, described by the writer in the Trans. of the Mining Association of Nova Scotia, Vol. II., p. 117.

ings, and thus gives a much surer and clearer idea of its condition than any number of sectional maps possibly can do.

The blast furnaces of Sweden—as well as in the Lancashire process of making wrought iron—are all using charcoal as fuel, and in most of the other metallurgical operations, such as the roasting of the ores, in the heating and open hearth furnaces, etc., the generator gases from wood, forest and mill refuse are used to a great extent. The coal mines of Sweden, namely, which occur only in the extreme south part, in Skane, and from which in 1896 nearly 250,000 net tons of coal were raised, are not of sufficient purity for the iron industry, but are mostly used in the manufacture of firebricks, as good fire clay is associated with the coal beds. Hence it is that sawdust and slabs from the mills, branches and stumps from the forest—in fact anything of a combustible nature—is carefully saved and used in the gas producer, where it is made into pure gaseous fuel, free from sulphur, and thus most admirably suited for the iron and steel processes. Besides the abundance of waterfalls furnishes power for this as well as most other industries, thus leaving for the smelting processes, the lumber and pulp industries, almost the exclusive use of the raw materials of the forest. And as of old the Swedish ironmasters also have been large forest owners, the interests of both these industries have been identical, and the future and continuous prosperity of both have been looked forward to by planting, as well as cutting, and by a systematic working of and most scrupulous saving of the forest products.

Of all the iron and steel exhibits at the Stockholm Exposition it can be said that this excelled in exceptionally good products, and showed an unusual taste and system in arrangement. Conspicuous was also the diversity of products from the same works, showing how few of them really confine themselves strictly to any one particular branch, and how many convert their own raw material—pig iron billets or ingots—either into a half-finished product or into even the smallest articles of trade, many also going into the manufacture of lumber, pulp and paper, etc. The reason of this is evidently to avoid being dependent on the price fluctuation of the raw material, and to enable them to throw the bulk of their working force on that branch, among the different ones pursued, which at the time promises the largest profit.

Owing to the great demand for Swedish bicycle tubes during the last few years quite a new important industry has of late sprung up—namely, the manufacture of tubes of all dimensions. Another healthy branch of the iron industry is evidently the open hearth—especially the basic—process, which is growing in great favor, and from which large castings, as well as small samples were shown at most of the exhibits that testify to the great excellence of the material.

In 1896 there were 140 blast furnaces in operation, producing 544,858 net tons of pig iron, as compared with 502,625 tons in 1890—thus showing but a slight increase, which again is principally due to the limitation of the blast furnace fuel (the charcoal). The average output per furnace and working day was 14.3 net tons in 1896, and 13.3 in 1890, and the largest furnaces (at Domnarfuet) having produced an average of 28.9 net tons, while, of course, some of the smaller furnaces make considerably below the average. The tendency of the Swedish iron industry is indicated from the following table, which gives the proportions of the different kinds of pig irons manufactured in 1892 and 1895:

	1892. Per cent.	1895. Per cent.
For Lancashire and puddling	62.12	52.70
" Bessemer and open hearth	30.53	43 46
" laundry purposes	2.05	1.69
" malleable castings	1.10	1.86
Sprigel	0.19	0.29
	100.00	100.00

For the further manufacture of the pig iron into wrought iron and steel there were, in 1895, 137 different works, and the number of furnaces and the quantity of each class of iron produced were as follows:—

	Net tons.	
306 Lancashire forges, producing	190,517	
35 Franch-Comte forges, producing 33 Walloon forges, producing 16 scrap forges, producing	15,484	
Puddling furnaces at only 4 works, produciug	1,975	
		207,976
30 Bessemer converters, producing	107,247	
(Of which 19,672 tons are basic steel.)		
33 open hearth furnaces, producing	109,383	
(Of which 22,060 tons are basic steel.)		
5 crucible steel furnaces, producing	659	
		217,289
6 blister steel furnaces, producing		720
Total net tons		425,985

In order to give an idea of the different kinds of manufacture, and the growth during the last few years the following table is of interest

1 metric ton = 1.102 net ton. = 0.984 gross ton.	1891 Total metric tons.	1891 Per cent. Lancashire puddling.	1891 Per cent. Bessemer and Martin.	1895 Total metric tons	1895 Per cent. Lancashire puddling.	1895 Per cent. Bessemer and Martin.
Blooms, billets, etc., for export	8,083	0 1	99 9	9,488	0.14	99 86
Iron and steel bars	146,786	67.8	32 2	168,270	61 32	38 68
Other shaped iron and steel not hereafter specified	8,324	8 0	92 0	12,171	1 29	98 71
Hoop iron, horse nails	78,092	59.3	40.7	78,168	55.63	44 37
Wire, in coils	25,764	40 4	59 6	26,038	32 38	67 62
Heavy plates	10,850	0.7	99 3	12,028	0.51	99 49
Rails	3,644	..	100.0	2,884	..	100.00
Fish plates and rail plates	384	45.3	54.7	387	40 31	59 69
Wheel tires	1,391	..	100.0	900	..	100.00
Axles	1,975	34 9	65.1	1,897	17 34	82.66
Anchors and other heavy forgings	1,009	59.2	40.8	695	28 63	71 37
	286,302	55 3	44.7	312 926	49 86	50 14

From this we see that the percentage of Bessemer and Siemens-Martin metal in the manufacture of domestic material was below that of Lancashire and puddled iron until a couple of years ago, when it exceeded it; and the increase in this direction is steadily growing. Another table, showing the relation between hammered and rolled billets and bars and the increasing preference for the rolled product, may also be of interest:

Year.	Hammered. Tons.	Hammered. Per cent.	Rolled. Tons.	Rolled. Per cent.
1892	46,693	34.1	90,306	65 9
1893	43,072	31.8	92,479	68.2
1894	39,738	29.5	94,896	70.5
1895	37,381	24.2	117,229	75.8

Among the several iron exhibits, those of the Sandviken, Domnarfuet, Bofors and Tinspong were the most conspicuous; and the mentioning of a few of their articles will only go to demonstrate the opinion already advanced in regard to the excellent qualities of the Swedish iron and steel, as well as the superior skill displayed in the manipulation.

As samples of special skill in cold rolling long iron bands, the Sandviken Steel Company exhibited an iron band eight inches wide and 2,293 feet long, weighing 1,155 pounds, which decorated the walls and the ceiling of their pavilion, and as a contrast to this "heavy weight" we noticed a "light weight" champion of 4,205 feet in length, and 2⅜ inches in width, but only 43 pounds in weight. The thickness of this cannot be measured in the ordinary manner, as it is only about 0.0012 inch; but a still thinner one, measuring 0 0008 inch was also among these unique exhibits. Another "record breaker" was a band saw 12 inches wide and 214 feet long, handsomely polished and hardened, and "ready for work;" so was also a hot rolled band 290 feet long, 8 inches wide and 5 32 inch thick, weighing 1,241 pounds and made in one heat. This is believed to be at the same time, the heaviest and longest band ever produced in a similar manner in any part of the world. Below this coil was placed a billet of the size from which this band was formed, measuring 11 feet by 7¾ by 4⅜ inches, which object lesson makes one realize with what skill and dexterity this great change of dimensions must have been accomplished—as the result of only one heat.

Domnarfuet Iron Works—the largest iron and steel works in Sweden, and the largest in the world based on charcoal as fuel—displayed some heavy chilled castings, *e.g.*, two 26-inch rolls, about 11 feet in length, and weighing 16,975 pounds each; also open hearth castings, among which two 31-inch rolls of 17,195 pounds weight, and a piston of over six feet in diameter and 3,858 pounds in weight; so also a multitude of samples which had been subjected to the most trying mechanical tests, under heavy drop hammer or by strong torsion and bending, to prove the excellent quality of the material, as none showed any sign of a break or flaw. The superiority of the Domnarfuet tool steel was proved by showing the work done by some of them (duly attested): One of the turning tools had cut and turned off 2,336 pounds of open hearth steel shavings, 566 pounds of cast-iron turnings and 50 pounds of shavings from a chilled cast-iron roll; while a 2-inch spiral drill had bored holes of together about 14 feet depth, making 130 pounds of chips. Among car wheels exhibited by the Sandviken Iron Co., one pair had served during 21 years, and traveled 458,296 miles, and a pair of locomotive tires which had been running 236,817 miles in ten years; also a car axle that, after having run 444,845 miles, was tested and had to be bent 39½ times at an angle of about 10 inches from the neutral axis before it broke.

At Bofors and Tinspong guns, armor plates and projectiles are made, of which the latter especially are renowned at home and abroad,

and their power of endurance was shown at a trial practice at Creusot, when the three Tinspong 5.9 inch composition projectiles passed unharmed through the 9.8 inch armor plates made by the French works for the Swedisb Government.

The good welding quality of the Swedish steel, as well as the skill of the blacksmith, was demonstrated in a most interesting manner by a piece of steel in the shape of a cube, the end sections of which showed nine small steel squares of different hardness. This effect had been obtained by a perfect welding together of nine square steel bars, with carbon ranging from 0.2 to 1.0 per cent., after which this composite bar had been cut in pieces and polished.

In order to show to what great expense the Swedish ironmaster is prepared to go in order to gain even the slightest advantage in quality of product, it is interesting to note that at some of the works using the purest ores obtainable, they are actually killing out the birch wood, and in its stead planting pine, solely on account of that shade of a difference in amount of phosphorus present in the hard wood, over and above that in the soft wood. But as the trade gives preferences to him who can show the absolute lowest percentage of phosphorus in the steel—if even a difference of .001 per cent.—the wis ironmaster will go even to such a sacrifice—cost what it may, as long as the importer is willing to pay for it—and this England, at least, is always prepared to do for *the very best* material.

Peculiar to the Swedish iron works are their large number of dwelling-houses owned by the companies; but, generally, furnished rent free to the workmen. Although both expensive to build and to maintain, at most of the works this rather patriarchal system is adhered to, instead of allowing the men to buy their own plot and house. Generally, these are neatly built cottages of brick or logs, and pleasantly situated in some park or the woods surrounding the works, and give the impression of prosperity and comfort.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during March and the three months ending March, 1897, 1898:—

	Month of March.		Three months ending March.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£4.955	£2,113	£12,018	£5,418
Pig iron	20	639	455	2.541
Bar, etc.	830	78	3,031	2,285
Railroad	3,295	....	3,847	6.922
Hoops, sheets, etc.	2,700	869	6,311	3,653
Galvanized sheets	2 615	1,916	5,841	4.549
Tin plates	23,141	7.034	61,542	25,549
Cast, wrought, etc., iron	2,252	2,162	7,004	6,133
Old (for re-manufacture)	96	323	572	403
Steel	5,302	5,295	10,235	15,935
Lead	791	1,121	2,070	2,703
Tin, unwrought	947	2,087	5,444	3 476
Alkali	2,606	2,617	4,522	5,516
Cement	750	81	1,843	1,988

MONTREAL ISLAND BELT LINE RAILWAY.

We described at some length in our last issue the Montreal Island Belt Line Railway. The following additional details of the equipment have kindly been supplied us by C. H. Wright, electrician, and R. Welsford, engineer of the company: The generatoi is the well-known Canadian General M.P. 200 belted dynamo, and runs at a nominal pressure of 550 volts. The switchboard is the standard marble generator panel, made by the same company, and furnished with its circuit breaker, switches, etc., while the indicating instruments are of the Weston switchboard pattern. The four closed cars are mounted on Taylor double trucks, and equipped with G E. 1,000 motors. The two 45-feet cars are mounted on Taylor double trucks, with G E. 1,200 motors. The five 30-feet cars are mounted on Brill single trucks, with G.E. 800 motors. The cars are made by the General Electric Company and the Ottawa Car Company. They are lighted with about 225 candle power of incandescent lamps. The line is 00 trolley, with a parallel feeder of 0000 bare wire from the power house, and tapped every 1,000 feet to the end of the line. Bracket construction is used, and the trolley wire is 22 feet from the ground; soldered ears and Crayhead brackets make the overhead work very durable. The bonding is 0000 solid wire, with malleable iron thimbles sweated on. Rails were drilled in the pile with upright hand drills. The cars are controlled by a non-inductive telephone system from the superintendent's office at the power house. The car sheds are located at the power house, so that all the operations of the line are controlled from this central point. The line is completely fenced with Page steel wire fence. The River Side power house of the Montreal Belt Line Railway is situated on the banks of the St. Lawrence, and in the middle of its line. The power house is built of pressed brick of the Ormstown manufacture. The size of the building is 44 feet by 84 feet. The engines and boilers are made by Goldie & McCulloch, Galt, Ont., and consist of one double tandem compound Automatic Cut-off engine, size 13 x 24 x 36 inches. The wheel, 16 feet 6 inches, is belted directly to generator. The boilers are made from the best homogeneous steel, and are double riveted with 84 tubes in each, and tested to 180 lbs. pressure. The condenser pumps and boiler feed pump are made by Northey of Toronto, whose wares are well known to manufacturers. Size of condensers are 6 x 12 inches, and 9 x 12 inches. Size of boiler duplex feed pump 6 inches, 4 inches x 7 niches. The horse power of the engines is 300.

JAMES KINOCH, CHIEF ENGINEER CANADIAN GENERAL ELECTRIC COMPANY.

Jas. Kinoch was born at Blair Gowrie, Perthshire, Scotland, in 1866. The greater part of the years spent in securing his education were passed in London, where he attended the City of London Middle Class School. His technical education was completed at the City and Guilds of London Institute, under the tuition of such able instructors as Profs. J. Perry and W. E. Ayton, and Sylvanus P. Thompson. He graduated from the Institute with great credit to himself.

After completing his technical studies Mr. Kinoch entered the employ of the Globe Electric Engineering Co., where he remained for three or four years. He then became secretary of the Orient Electric Light Co., which position he retained for nearly two years

JAMES KINOCH.

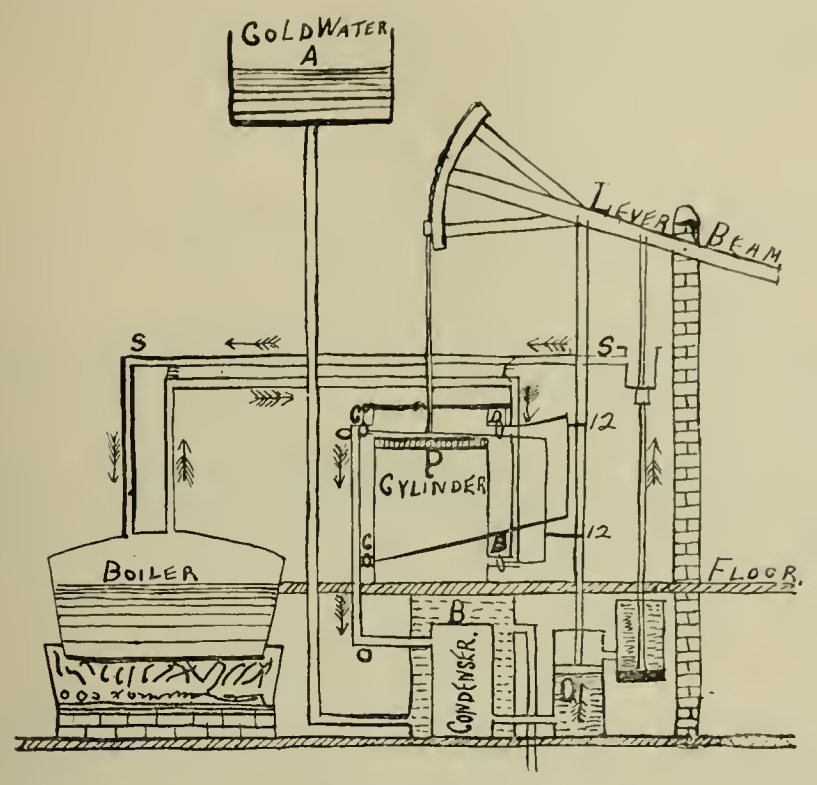
After two years' experience as chief assistant to Killingworth Hedges, Mr. Kinoch came to Canada in October, 1891, and entered the service of the Edison General Electric Co. in Toronto. When this company combined with the Thompson-Houston Electric Co., and the Canadian General Electric Co. was formed to carry on its business in the Dominion, Mr. Kinoch was employed as estimating clerk. He filled this position, except for a short time spent with the construction staff on the road, till he was appointed assistant to the chief engineer, and last month received the appointment of chief engineer to the Canadian General Electric Co.

THE STEAM ENGINE.

Editor THE CANADIAN ENGINEER.

SIR,—In a former paper to your readers I drew their attention to the horse-power or duty, and to Newcomen's atmospheric and steam engine which Watt repaired for the University of Glasgow. His attention was directed to improvements which he saw could be made, and he and Dr. Roebuck went to work to make a new one of a useful size for the Doctor's mine; in his house and in his Carron iron works he fitted rooms for the purpose; there we left him, getting his patterns and casting ready. They had undertaken a big job, as all their tools had to be planned and made. We will now follow him into his room, where he had his steam engine working. Herewith I present a sketch of the engine that was in his mind some time before. The condenser is below the steam cylinder, in a tank of cold water to help the spray or jet of water inside; also he had two pumps connected to the main beam to draw the water out of the tank, and also to fill the boiler feed tank. Here, you may observe, his engine worked with steam both sides of the piston. It was made to work any machinery, as well as pumps in a mine. This condenser formed a better vacuum than could be formed before, and his engine made about fifteen to twenty strokes per minute and ran much higher pressure steam, and by making the vacuum in the condenser as good as possible, so that he might gain 12

or 14 lbs. on the square inch; or, in other words, his pressure of steam on the piston may be that amount less in the boiler; his valve levers are connected to the main beam. The next gain he wanted to make was to keep the cylinder warm, it being exposed to the cold air, as well as the pipes to it from the boiler. He conceived the plan of having another cylinder fitted around it and cased with wood, and let in a little steam at the top, and the condensed water ran out at the bottom.



WATT'S ENGINE.

A, *B*, cold water tanks. *C*, outlet for cold water. *D*, *F*, pumps for drawing off hot water and sending it along *s s* back to the boiler. *P*, tight-fitting piston. *a*, *d*, cocks for letting steam into the cylinder. *b*, *c*, cocks for letting steam out of the cylinder. *e*, *e*, pipe which carries steam from boiler to cylinder. *o*, *o*, pipe which carries steam from cylinder to condenser. *1*, *2*, rods connecting the cocks with the lever-beam.

which answered well. This engine he called a condensing engine, and so it is to-day. The piston rod was put through the cover with a gland and stuffing box, as we have to-day, but his workmanship was not so good as ours is: for want of suitable tools, he had quite a difficult piece of work to plan and make the parallel motion. The former engines had a chain over a circular piece at the end of the main beam, the piston rod being a square bar, and a little motion of the piston in the cylinder did all that was required. His piston he made of iron, with a cover or follower, with a space left to pack or caulk in plaited hemp and tallow; when the follower was screwed down it squeezed it against the sides of the cylinder and made it steam-tight. This make of piston I have packed. and it worked well in a slow-motion mine engine with low pressure. Mr. Watt had many other difficulties to be overcome; he yet had taps for admitting and letting out the steam, which were opened and shut by the motion of the main beam, not by hand, as in Newcomen's. But a better sort of arrangement had to be planned out and made; time and money were going away, and none coming in. He lived with the Doctor, and many people were talking about Watt and his new engine.

Watt's mind was fully engaged in planning a valve, in the place of the taps. His leading idea was to have the two valves connected, so that when the top valve opened to let in the steam on top of the piston, the one in the bottom will open to let it out from under the piston at the same time into the condenser. Out of these ideas grew the old Cornish D. and equilibrium valves, also the lever nozzle and foot valves for the condenser. He found his boiler not large or strong enough, because he wanted more steam and higher pressure, and the saving of more steam, also condensing it every half stroke must be done in less time. To do this he got a large tank made and put his condenser into it and covered the condenser all over the top and sides with cold water, the pipes through which the steam passed into the condenser and the condensed water came out to the feed pump, passed through the sides of the tank and the water in it, so that the steam was condensed in much less time. The water in the tank was pumped for use or waste; being warm, cold water was running into the tank to take its place; the two pumps were connected with the main beam. By this plan he had saved a large amount of steam and his engine ran much better and faster, he then put a safety valve on the boiler, and two gauge taps, and caused the fire to burn faster by enlarging and raising the chimney, but he soon found the heat he had in the furnace was 75 per cent. more than was found in the water and steam. In fact, he calculated that only 25 per cent. went into the steam, he also found it took 6 lbs. of water at 32 degrees to condense 1 lb. of steam at 15 lbs. He found that one inch of water at 32 degrees will expand into one cubic foot or 1,728 inches at 15 lbs. There are reasons for believing that these several states of matters are determined by certain conditions affecting the molecular arrangements We find that one pound of hydrogen, united with eight pounds of oxygen, will produce nine lbs. of water, giving off a considerable quantity of heat. It must be borne in mind that these two elementary substances exist as free gases, so that they can be united or used separately. The word latent means hidden and in this sense we will use it. If we take a glass flask, put it on a stand with a lamp under it, one that will give off a continuous and even heat, put into the flask one pound of water at 32 degrees; watch it taking in the heat, and in one minute, the thermometer will be, say 10 degrees higher. We will now remove the lamp and water, and put into the flask one pound of ice, put back the same lamp and watch the time it requires to melt the ice into water. It takes 14 minutes, but the thermometer marks only 32 degrees the same as the ice did. If the lamp put 10 degrees into the water from 32 degrees to 42 degrees in one minute, then the lamp must have put into the ice $10 \times 14 = 140$ degrees, but the thermometer does not show it, this is what is called latent heat concealed in the ice, which is required to bring back the ice to water. We will now put the lamp on again with the one pound of water which came from the ice at 32 degrees and watch the time it will require to boil up to 212 degrees, the thermometer says steam. It has taken about 18 minutes, or 18m. $\times$ 10° = 180° + 32° = 212°. Now without disturbing any part of it, watch the time it will require to boil all the water away, and force the steam into another flask through a connecting glass tube, 95 minutes or $5\frac{1}{2}$ times the 18 minutes the time it took to boil from 32 degrees up to 212, and yet the temperature has not risen by the thermometer above 212 degrees, 10 degrees in one minute being raised by the thermometer has become our unit 14m. $\times$ 10° = 140°. 18m. $\times$ 10° = 180° $\times$ $5\frac{1}{2}$ = 990° + 180° + 140° = 1310° -- 212° = 1098° latent heat in that one pound of ice, up to steam equal to the pressure 15 lb. atmosphere, and if we get steam up to 60 lb., 14 steam atmospheres, we will get into that steam 294 degrees or 82 degrees above 212 degrees; 8 atmospheres will give 342° = to 130° above 212°. Fahrenheit's thermometer. After laying these figures before you, 1098° latent heat and sensible heat 212° + 1098° = 1310° for one atmosphere 15 lb. or 4 atmospheres 60 lb. 1310 + 82° = 1392° or 8 atmospheres, 1392 + 130° = 1522° in steam 120 lb.

About the year 1766 little was known about the air or atmosphere. Watt was very anxious to know something more about it, for he could not burn the fuel without the air, and he wanted to know how to regulate its supply to his furnace in a practical way.

Watt's boiler is what is called the wagon boiler; the bottom sides and ends are curved inward, the top is like the cover of a wagon curved up, made strong with stays to resist the pressure of steam, say 50 lbs. It was built in with bricks, with a chimney behind; when the fuel was put into the furnace, he found it required to be of a light article so as to give a blaze to drive out some of the heavy atmosphere, the chimney and furnace being full with a weight to be overcome by the blaze. The oxygen and hydrogen in the air combined to form drops of water on the cold boiler, and until sufficient heat has been raised to change the water back again into gas, and the atmosphere is driven out of the furnace and chimney, and the bricks have taken in sufficient heat, the fire must burn; and to create a draught in the furnace and chimney the fire must burn, and a large amount of fuel consumed; the heat cannot be brought back or saved for use again, it has done its duty in lifting a weight out of the chimney. Watt complained that not more than 25 per cent. of the heat is caught in the water and steam, while 75 per cent. was gone up the chimney to warm the atmosphere. We will now learn a little from our scientific friends about it; it is a mechanical mixture, not chemically combined, and when in its purest state consists of oxygen, 20.96; nitrogen, .79, and carbonic acid gas, .04, one cubic foot at 32° with a pressure of 14 7 lbs. or 30° mercury weighs 565 1 grains, and one pound is equal to 12.387 cubic feet; it varies one grain for each degree of heat, and is 773 times lighter than water at 32°; the mean weight of a column one foot square, say 45 miles high, weight 2,124.7 lbs. $\div$ 144 = 14.7 lbs. per square inch, or $\div$ 62.5 will support a column of water 34 feet high, or $\div$ 846 lbs. (the weight of a cubic foot of mercury); it will support a column of mercury 30 inches high. If we build a chimney 60 feet high, for a boiler 60 inches diameter by 16 feet long, with tubes sufficient for an engine 24-inch cylinder, and a 36-inch stroke, the inside flue of the chimney should be at least 24 inches square. A round flue is the best; we have at the bottom of the chimney the atmosphere pressing 2124·7 $\times$ 4 = 8498·8 lbs. This great weight must be moved before we can reverse the pressure and cause an upward draught, and to do so we must burn some pounds of light fuel, and also to heat the brick in the furnace and chimney; this heat has to be kept up or maintained by the burning of the fuel, beside the heat or energy put into the steam for actual work every minute. I do not wonder at Watt being much surprised to find that his engine did not get more than 25 per cent. of the heat or energy produced from the fuel. The engineers

of to-day are complaining of the same thing, and many of them say: "We have brought the engine to a nice appearance for workmanship, economy and usefulness, but the principal part we have so far not handled successfully, viz., how to build in our boilers; are they made of the right stuff and shape, and our chimney," could not some other material be used, mica, or anything that will not give off so much heat? When this 25 per cent. loomed up in Watt's mind, he planned a different shape boiler. In one he put two large tubes in a round shell with a fire in each; but he found, if both the fires were not kept alike, it did not do justice to the boiler, and the water inside he then put in one large tube, and put the fire into it, hoping to get more heat into the steam than when the fire was outside, he found it worked better; this plan is now generally adopted in different shapes, but this plan did not, nor does it now, save the large percentage of heat leaving the boiler and going up the chimney to keep out the pressure of the atmosphere and give an upward draught or upward current not to burn, the air or oxygen, as some say, but to change the hot atmosphere and fuel into gas. A large number of new inventions have been made within the last few years, yet we are not perfect; but there is plenty of room for new plans left."

THE CONSTITUTION OF HYDRAULIC CEMENTS.

A series of experiments to determine the constitution of hydraulic cements has recently been made by S. B. Newberry and W. B. Newberry and described in a paper read before the Society of Chemical Industry. The questions which the authors have attempted to solve are as follows:—

1st. What proportions of lime must be employed for given percentages of silica and alumina in a clay? 2nd. Can a general formula be stated, applicable to all clays, which shall indicate the proportion of lime which will give the best result with each? 3rd. What effect has the presence of oxide of iron in the clay used on the proportion of lime required, and on the quality of the resulting cement? 4th. Is the presence of alkalies in the raw materials necessary to the production of good cement? 5th. Is magnesia capable of replacing lime in cement mixtures, or is it inert, as has often been stated, and how does magnesia affect the quality of the cement obtained?

The plan followed in the efforts to solve these questions was that of synthesis with pure materials, which materials were as follows:— 1st. Silica; ground quartz, in impalpable powder, containing 99.19 per cent. silica. 2nd. Alumina; C. P. precipitated, containing 99.50 per cent. alumina, .20 per cent. soda, .05 per cent. iron oxide and .25 per cent. silica. 3rd. Carbonate of lime; precipitated chalk, containing 99.7 per cent. calcium carbonate. 4th. Iron oxide; red, German C. P. 5th. Magnesia; German, C. P., containing only traces of silica, alumina and lime.

All these materials were in the form of a perfectly impalpable powder, and none of them left any residue on a sieve of 180 meshes to the linear inch. Mixtures of these materials, in calculated proportions, were made by rolling backward and forward on a large sheet of paper, then sifting three times through a 60-mesh sieve. The mixtures were then moistened with water, made into a cake, dried and broken into small pieces for burning. The burning was done in a Fletcher gas furnace, using gasoline gas as fuel.

The conclusions to which the writers are led by the above experiments may be briefly stated as follows: 1. The essential constituents of Portland cement are tri-calcium silicate, with varying proportions of di-calcium aluminate. This composition may therefore be expressed by the formula—

$$X\ (3CaO.SiO_2) + Y\ (2CaO.Al_2O_3).$$

From this formula it may be calculated that the correct proportion of lime, by weight, in Portland cement, is 2.8 times the silica plus 1.1 times the alumina. 2. Iron oxide combines with lime at a high heat, and acts like alumina in promoting the combination of silica and lime. For practical purposes, however, the presence of iron oxide in a clay need not be considered in calculating the proportion of lime required. 3. Alkalies so far as indicated by the behavior of soda, are of no value in promoting the combination of lime and silica, and probably play no part in the formation of cement. 4. Magnesia, though possessing marked hydraulic properties when ignited alone, yields no hydraulic products when heated with silica, alumina or clay, and probably plays no part in the formation of cement. It is incapable of replacing lime in cement mixtures, the composition of which should be calculated on the basis of the lime only, without regard to the magnesia present.

—The Government of New Brunswick has placed an order with the Good Roads Machinery Co., of Hamiton, for ten steel Champion road graders. The company is also shipping one of its well-known Champion rock crushers, road rollers and engines to the town of Magog, Que.

TO ESTIMATE HORSE POWER.

Editor CANADIAN ENGINEER:

(a) In the question below please inform me in THE CANADIAN ENGINEER why "3" and "2" are used, that is, where they get the "3" and "2" in the text book of which I am studying. The question is: Required the horse power of an engine having one cylinder 30 inches diameter, 36 inches stroke, making 90 revolutions per minute, boiler pressure 75 lbs. per square inch, cutting off at ¼ stroke, vacuum 26 inches, mean effective pressure on piston throughout stroke 50.5 pounds per square inch.

$$\frac{30 \times 30 \times .7854 \times 50.5 \times 3 \times 90 \times 2}{33000} = 584.1234 \text{ H.P.}$$

(b) Does black oil in a boiler destroy the scale, or does it injure it?

YOUNG ENGINEER.

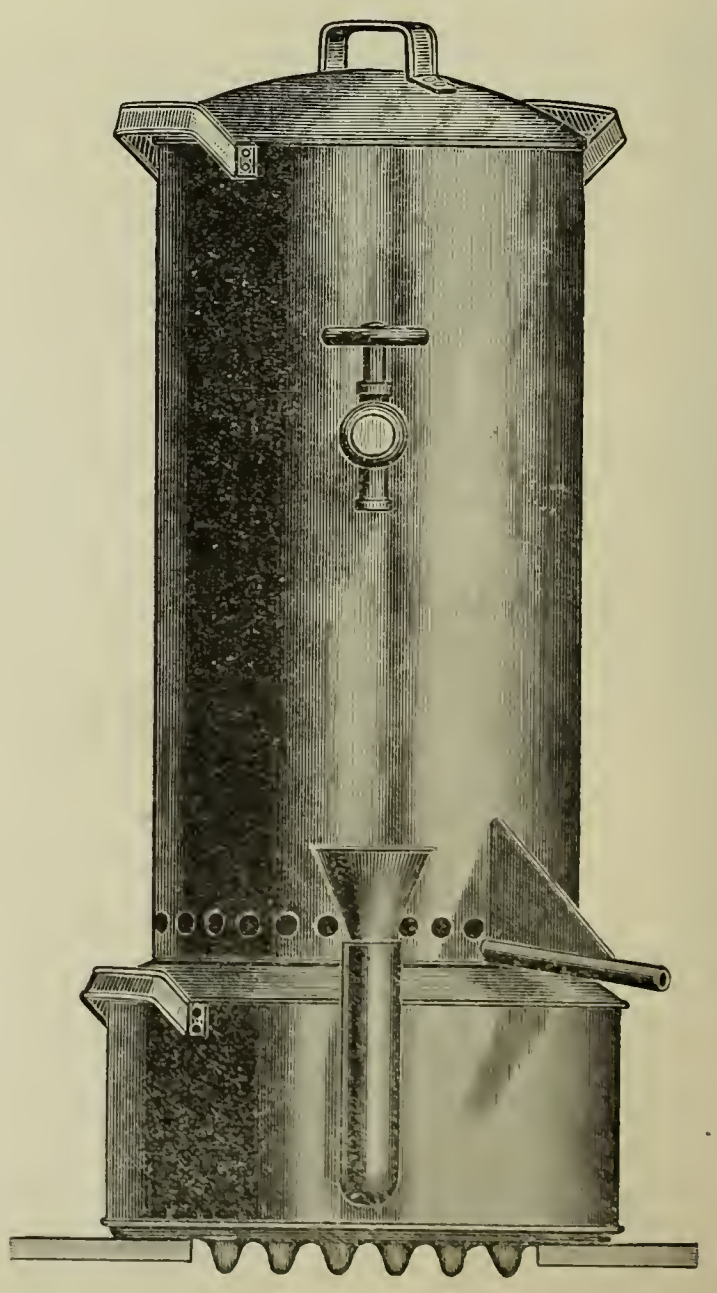
Midland, Ont.

(a) The "3" referred to here by our correspondent is the number of feet in the stroke, and the "2," is the number of revolutions per minute.

(b) The Boiler Inspection and Insurance Co. does not allow the use of oil as described. We would advise "Young Engineer" to write to some of our advertisers for information on the subject of scale in boilers.

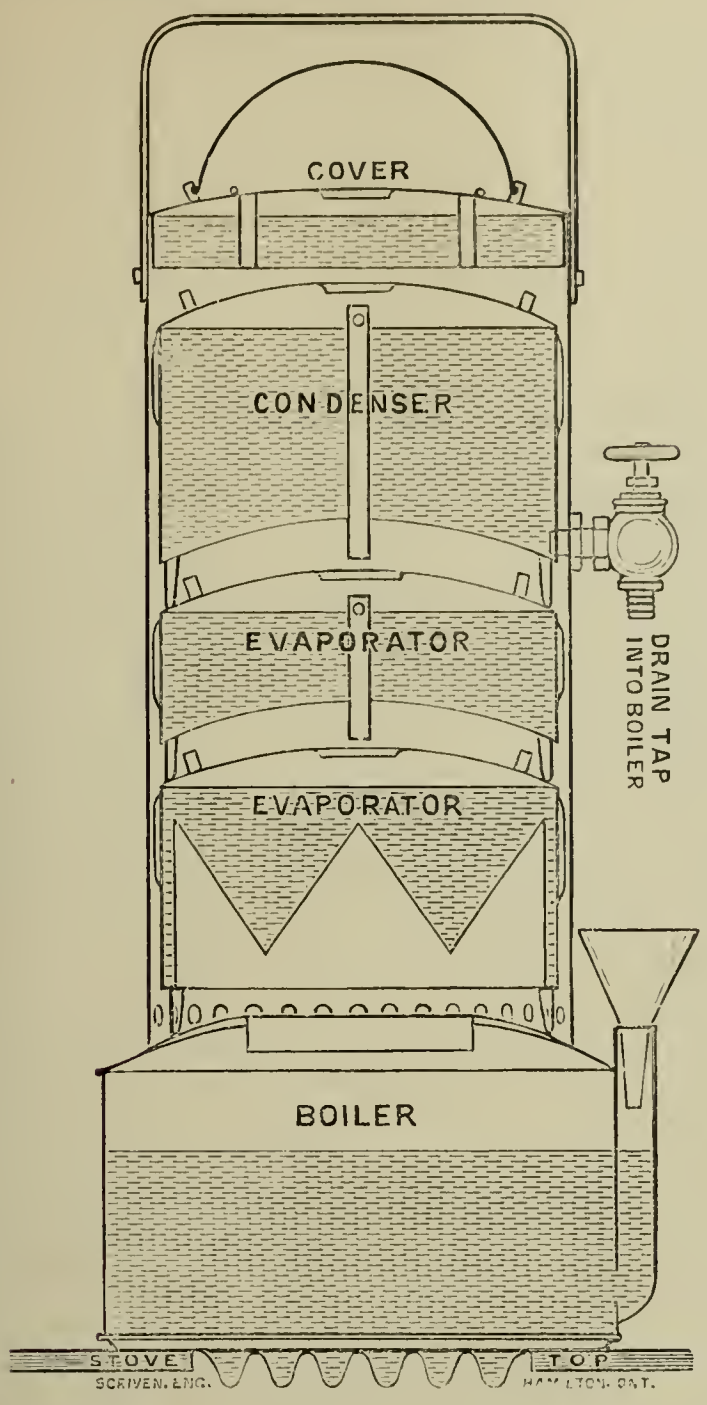
DISTILLED WATER.

The accompanying illustrations show the New-Life Water Still for producing aerated distilled water for drinking, culinary and hygienic purposes. The action of the apparatus is as follows: The water to be operated upon is placed in the lower vessel or boiler, and when boiling is placed on the kettle, and the steam passes into, around and under the evaporators, heating them to nearly boiling point, by which a part of the water they contain is evaporated and is condensed by contact with



the upper vessel or condenser; a constant current of air passing through the holes at the bottom of the condenser is carried up and sterilized by coming in contact with the steam, and, the maker claims, combines with the product, which is pure distilled water, freed from all calcareous, organic and deleterious matter. The water is pleasant to the taste, satisfying, will relieve thirst, and can be borne by a weak

stomach when "raw water" is not possible, and being divested of all injurious solids, acts as an absorbent, assisting nature to carry on the natural functions of the system.



The New-Life Water Still is the invention of J. H. Killey, mechanical engineer, Hamilton, and is protected under industrial design No. 1,360, and manufactured by the New-Life Still Co., 37 King William Street, Hamilton, Ont.

ONTARIO LAND SURVEYORS.

The sixth annual meeting of the Association of Ontario Land Surveyors was opened pro forma at the Repository of the Association in the Parliament Buildings, Toronto, on Tuesday, 22nd February, and adjourned to meet at the same place on the 8th March and the two following days. At the adjourned meeting the chair was occupied by T. Harry Jones, of Brantford, president. The attendance was larger than at any of the last three preceding years, and a lively interest in the proceedings was shown throughout.

Meetings of the council of management, board of examiners, and the standing and special committees for the association, year 1897-98, occupied the morning of the first day, the first session of the general meeting being held in the afternoon. The minutes of the previous meeting having been published in the annual report for 1897, the formality of reading them was, on motion, dispensed with. Letters were read from C. E. Gauvin, president of the corporation of Provincial Land Surveyors of Quebec; W. F. King, Dominion Astronomer; Capt. E. Deville, Surveyor General; Herbert Wallis, past president of the Canadian Society of Civil Engineers; Professor McLeod, secretary of the Can. Soc. C.E.; also from Joseph Kirk, of Stratford, an active member of the association, now in his 88th year, and from Sandford Fleming, C.M.G. A communication from the mayor of Hamilton, through E. G. Barrow, city engineer, inviting the association to hold its next annual meeting in that city, was also presented, and M. J. Butler and George Ross were appointed a committee to frame a suitable reply thereto. The president then introduced Wm. Hamilton Merritt, who exhibited a field equipment for prospectors, and explained the method of operating it. Its weight being only 27 lbs., it is easily transported, and would serve a useful purpose. The annual address of the president was next read, and a brief account of the history of the association during his term of office therein presented. V. Sankey, chairman of the council, presented the report of the council, including those of the board of examiners and secretary-treasurer, the financial statement being then handed to the auditors for verification. From these reports it was shown that the association had lost nine members by death during the preceding year, and eleven candidates had been admitted to practise at the two meetings of the board of examiners.

Reports of the committees on Publication, and on Repository and Biography, were read by Captain Gamble and H. L. Esten, the president announcing that a suitable album had been procured, and requesting that members who had not already done so would present their photographs to the last-named committee. In the absence of V. M. Roberts, his paper on "Acetylene Gas and its Uses" was read by H. H. Gibson. This paper set forth the advantages of acetylene gas over other luminants. H. D. Q. Sewell then read a paper on "Progress on the Lake of the Woods," being a supplement to a former article which he had contributed.

D. D. James read a paper by V. M. Roberts on "Water Power from the Niagara River," and discussion of various sources of water power in Ontario and Quebec for conversion into electric energy followed the reading.

After referring to a number of schemes of power development, which were more or less visionary, the writer took up the plans of the Welland Power and Supply Canal Co. to construct a power canal from the Welland River to Lake Ontario. The proposed canal will be fifteen feet deep, one hundred feet wide at the bottom and one hundred and sixty feet wide on the water line, and the slope of its sides and banks two to one, having its intake on the Welland River near the village of Montrose, and will flow through the townships of Stamford, Niagara and Grantham to Lake Ontario, being fed by the Niagara and Welland rivers. The Welland River rises in the county of Wentworth, a few miles south of the city of Hamilton, and flowing through a comparatively level country empties into the Niagara River about two miles above the Falls and is navigable for some thirty miles above its mouth. A canal or cut was made some years ago by the Dominion Government from Chippawa, a small village at the mouth of the Welland River, southerly across the northeast corner of the township of Willoughby into the Niagara River, to allow vessels bound for Welland to enter the river without risk, connecting with the Welland Canal at Port Robinson. The current of the Niagara River forces its waters through this cut, and its influence is felt some twelve miles up the Welland River. Seven miles north of the Welland River the canal reaches what may be termed the Bluff, to distinguish it from the Niagara escarpment, of which it forms a prominent and isolated portion; seven miles north of this point is Lake Ontario. Between the point of intake and Lake Ontario there is a difference in elevation of 316 feet, of which 184 feet is available at the Bluff, 66 feet in the vicinity of the Queenston and Grimsby stone road, 33 feet in the vicinity of the Niagara stone road, and 33 feet at or near the mouth of the Eight Mile Creek, every foot of which can easily and with advantage be utilized for the development of power.

The engineering features in connection with this immense undertaking are, for the most part, of an extremely simple nature; difficulties similar in all respects to those which will have to be surmounted, having already been successfully overcome in the construction and maintenance of the new Welland Canal, which lies about two miles to the west, and is a standing proof of the feasibility of the power canal. In the spring of the year when the disruption of the ice which has formed in the Welland River during the winter months takes place, the extremely swift current of the Niagara River, above the Falls, keeps the mouth of the Welland River open and carries the ice away immediately, preventing ice jams. The intake of the canal will leave the Welland River about three-quarters of a mile above Montrose bridge, at such an angle with the river as will afford protection from ice coming down stream, and crossing a small knoll, enters the bed of a creek flowing into the Welland River about half a mile lower down, and follows its course for about one mile and a quarter, thence almost due north across the height of land to the bluff, crossing under the Allanburg cut-off of the Grand Trunk Railway and the St. Catharines and Niagara Central Railway, and over the Great Western Division of the Grand Trunk Railway, thence following the general course of the Eight Mile Creek to Lake Ontario.

The deep cut on the proposed canal will be about 65 feet, the slope of sides of cut and canal will be two to one in earth, and have a batter of one in twelve in rock. A short distance south of the crossing or aqueduct over the Great Western Division of the Grand Trunk Railway a regulating weir will be constructed of first-class masonry. The aqueduct will be similar in all respects to that on the new Welland Canal where it crosses the same railway about one mile to the west, being composed of a masonry tunnel, covered with puddle clay properly tamped and rammed to form the bed and banks of the canal. A storage basin or reservoir and head race will be constructed

at the bluff, which presents about six thousand feet of almost perpendicular sides, in the form of a semicircle, down which the water will be conveyed through steel tubes to the turbines. From the bluff to Lake Ontario the cutting will not be heavy, the canal being formed alternately in cut and fill, masonry dams and sluiceways being built at the point of power development.

At the opening of the evening session the president announced that a committee of the Can. Soc. C.E. desired to confer with the association, represented by a committee, on the subject of the proposed incorporation of civil engineers in Ontario. Messrs. Sankey, Butler, Niven and Gaviller were then appointed to discuss the matter with the representatives of the civil engineers, and report to the association before the close of the annual meeting. An interesting report on "Exploration" was then read by E. Stewart, chairman of that committee, and discussion ensued, after which a paper on "Forestry in its relation to Land Surveying" was read by T. H. Southworth, Provincial Clerk of Forestry, who showed the immense importance of attention to this subject to the future of Canada. His statements were heartily endorsed by several speakers, M. J. Butler adding facts and statistics in support. The Economic Resources of the Hudson Bay District was the subject of a paper by J. W. Tyrrell, whose experience and observation in the far north made him an undoubted authority on many of the particulars as to the wealth of that part of the Dominion, so little known to the great majority of Canadians. Capt. J. D. Williams presented a paper on "Some Causes of Loss in Gold Mining in Ontario."

Wednesday morning session opened with an announcement by the president that the publishers of THE CANADIAN ENGINEER had kindly presented to the association a number of copies of its issue of February, 1898, containing a biographical sketch of Wm. Ogilvie, the most prominent member of the association. A. W. Campbell, chairman of the committee on engineering, then read a comprehensive report of the works which had come under the notice of that committee during the year.

Capt. W. F. Van Buskirk read a paper on the Sewerage Purification Works of Worcester, Mass., and replied to several questions brought up by members in that connection.

The capacity of the works is now upwards of 15 million gallons per day, providing for the entire dry weather flow of the sewers. The lime used for precipitation is slaked and mixed with water in two tanks, 8 x 6 feet each, the mixture being agitated by compressed air delivered by perforated wrought-iron pipes placed in the bottom of the tanks. The milk of the lime is delivered to the main outfall sewer by an iron pipe entering at a point about 100 feet above the screen chamber. Sulphate of alumina was formerly used with the lime, but was discontinued. The quantity of lime used is about 900 lbs. per million gallons of sewage, or 40 tons per week, at a cost of $6 per ton. This quantity is much less than is generally used, owing to the fact that the sewage of Worcester contains at times large quantities of iron salt from wire works, which is run into separate tanks and used gradually in connection with the lime. After receiving its charge of lime the sewage passes through a screen chamber, where all large substances are removed; thence flows down a mixing channel with rather a rapid fall to the channels between the settling tanks, whence it is directed, along with a small amount of the sewage containing the iron salts, into the various tanks by means of movable flash boards. The sewage passes slowly from one tank to another, the solids in suspension gradually sinking to the bottom, until it reaches the last one in operation, whence it flows out over a weir to a channel which conducts it to the river. The effluent looks bright and transparent, but appears to contain a considerable quantity of lime in solution at times, as the stones with which the outlet channel is paved were coated with lime. From one to three tanks are "cut out" each day, and after being allowed to stand quiet for a short time, the clear liquid is drawn off by means of hinged floating arms from pipes provided with valves passing through the walls of tanks. The sludge deposited in the bottom of tank is then run off to the sludge well through masonry channels located under the sewage channels between the tanks. It is then pumped from the well by a Shone ejector, the air for which is compressed by power from a water wheel driven by the effluent from the tanks of the main outlet. After leaving the well the sludge is deposited on beds, where the water is gradually drained off. The sludge has not been utilized to any great extent, but it is reported to be growing in favor, and presses are being put in which will leave the material in a form that will permit of economical handling or disposal.

Notwithstanding the fact that nearly all of the suspended matter is removed, the town of Millbury entered action a short time ago to compel the city of Worcester to further purify its sewage, and in consequence of such action the city employed Samuel M. Gray and Dr. Drown to make a report on the plant. They have recommended that the effluent from the works be further purified before being discharged into the river, and for this purpose an area of ten acres is being prepared for sand filtration. There is a little doubt, however, whether this will abate the nuisance or not, as the river bed and mill ponds are still covered with the organic matter deposited before the works were put in operation, and during heavy storms since that time when the whole of the sewage was not passed through the tanks. The report above mentioned affords further evidence of the fact that purification by chemicals is an incomplete process and that the lime and organic matter remaining in the effluent may give trouble when discharged into streams and small bodies of water. The experience of Worcester is particularly interesting as being in all respects similar to the experience of England, where it is found that notwithstanding the many improvements in settling tanks and in the methods of applying chemicals, it is not possible to produce effluents of sufficient purity to be discharged into the smaller rivers without causing complaints, and as a consequence the effluents are generally subjected to further treatment by rapid filtration through gravel coke, or some such material. Chemical precipitation, it is true, may in some cases give a degree of purification sufficient for the conditions which obtain, but the writer is of opinion that it will in most cases prove less expensive to treat sewage by rapid filtration through gravel, aided by a current of air and when the conditions demand complete purification, the effluents can be filtered in the ordinary way at a very high rate per acre. It has been shown by experiments conducted by Board of Health of the State of Massachusetts, that rapid filtration through gravel or coke gives an effluent comparable in all respects with that obtained by chemical precipitation under the most favorable circumstances, and has the advantage that the sludge is disposed of, as it is consumed in the pores of the filter. Recent experiments in England confirm the conclusions of the Massachusetts Board of Health, and we may expect in the near future to find many of the chemical plants supplanted by more scientific and less costly methods.

A paper on "Evidence," that mysterious bugbear of candidates for admission to practice as land surveyors, was presented by M. J. Butler, whose training and practical experience in this connection fitted him to the task, and in the subsequent discussion it was suggested that Mr. Butler prepare a text-book on the subject, so far as it related to land surveying.

Sudbury waterworks was the subject of a paper prepared by L. V. Rorke, and, in his absence, read by D. D. James. This paper formed a valuable addition to the collection of articles on waterworks already published in the annual reports. Professor C. H. McLeod, secretary of the Canadian Society of Civil Engineers, having arrived from Montreal as a representative of that body, was welcomed and introduced by the president. The report of the Committee on Polar Research was read by J. W. Tyrrell, chairman.

The first order of business for the afternoon session was a paper by Jas. Hutcheon on "Specifications," containing many valuable hints.

A. P. Walker then read his paper on "The York Street Bridge," extracts from which appeared in the last issue of THE CANADIAN ENGINEER. "An Illustration of the Necessity for Accurate Descriptions" was the subject of a paper by George Ross, who gave the history of an important question of title to lands at Point Abino, Lake Erie, which had been the cause of much litigation. P. S. Gibson, well known to all surveyors admitted within the last thirty years, next read a paper on "Assessment Plans," describing the requirements of such plans and exhibiting a specimen sheet of a set recently prepared by him for the township of York.

The report of the Committee on Land Surveying, with Question Drawer, was presented by M. Gaviller, chairman, with answers to several knotty points sent in by members who appreciated the advantage of having an advisory board of experienced practitioners, whose duty it is to give the benefit of their opinions to any who seek them. A list of cases compiled by M. C. Schofield, an active member in the 80th year of his age, after 55 years of practice, was referred to the incoming committee for classification, and a question as to the position of shore or bank of a lake or river from which a road allowance is laid off, was also held over. The report of the Standing Committee on Topographical Survey was read by L. B. Stewart in the absence of the chairman, Otto J. Klotz. This committee continues its work, notwithstanding the lack of present results, but its efforts will eventually be crowned with success. M. J. Butler presented a description of sand cement, the product of recent improvements in manufacturing methods. This paper may be more fully discussed in a later issue. The evening was devoted to the annual dinner, that function which has done so much to promote a closer acquaintance among individual members, and which this year eclipsed all previous occasions in point of attendance and enjoyment.

The session of Thursday morning opened with the presentation of the report of auditors, which was read by H. L. Esten. A paper on the Kinburn Swamp Drain, prepared by F. W. Farncomb, was read in his absence by the secretary, and described a case where the judi-

cious investment of a few thousand dollars had resulted in the reclamation of waste lands, the value of which had amounted to several times the amount of the sum expended. H. J. Bowman read a paper entitled Arbitrators and Witnesses, dealing with the respective attitude which should be taken by each. In the absence of W. M. Davis, his paper on "The use of Field Tile for Large Drains," was read by A. S. Code. The writer showed the superiority of tile drains for several reasons. The following table gives approximately the comparative cost of open and tile drains of various depths:—

COST PER ROD.

Depth.	Open Drain.	Field Tile 6 in.	8 in.	10 in.	12 in	14 in.	18 in.
3 feet	$1 08	0 90	1.20				
4 "	1.80	0.96	1 26	1.86	2.19	3 00	
5 "	2.52	1 27	1.60	2.00	2.40	3 60	5.00

It would appear from the above that for depths up to 5 feet, and for sizes of tile up to 12 inches, the tile drain has the advantage, considering only first cost, and taking all things into account field tile of any size capable of carrying off the water, and for any depth, are cheaper than an open drain. In deciding on the size of tile it is not necessary to provide a capacity that would be ample for a culvert, neither is it safe to calculate on a drain having twelve months in which to dispose of the annual rainfall. In this latitude a rainfall exceeding one inch in twenty-four hours is exceptional, so that this quantity may reasonably be taken as a basis for our calculations. Not more than one-half the rainfall can be depended on to reach the trunk drain, a proportion which decreases as the area of the watershed increases. If the water can be removed within forty-eight hours, as a rule, no damage to the crops will result, therefore a trunk drain that will convey about 900 cubic feet of water per acre in twenty-four hours will be ample for ordinary drainage; lateral drains will require a greater capacity depending on the facility with which the rainfall reaches the tile.

Tile over twelve inches in diameter should not be less than two feet in length, as they can be laid more evenly; they should be particularly well burned, and moulded from the toughest clay; many qualities of clay, which make fair tile of small size, are totally unfit for hose of large diameter. The thickness should increase from one inch for 12-in. tile to $1\frac{3}{4}$ inch for 18-in. tile. Two factors of vital importance in drainage are: perfect alignment and grade; the curves should not have a less radius than 60 feet. An accurate grade can best be obtained by means of "boning rods;" that is, by placing two bridges across the trench about 300 feet apart, the tops being adjusted so that a line joining the top of one with the top of the other will be parallel with the grade line. A rod equal in length to the distance of this line from the grade line is then used to obtain the exact elevation of each tile; this method is especially advantageous when working in quicksand. Catch basins or manholes should be placed about 1,000 feet apart to admit of easy inspection of the drain; they should have a pit 18 inches below the grade line for the purpose of intercepting sand; they also provide a convenient means of connecting lateral drains Wherever possible, these catch basins should be placed at crossings of fences.

In accordance with the usual practice, the report of the committee on entertainment was taken as read, and ordered to be printed in the annual report. Professor McLeod addressed the association on the subject of proposed incorporation of civil engineers in Ontario, and explained its objects and its relation to the position occupied by land surveyors. The discussion on the report of council was begun, and lasted the remainder of the session. In the afternoon the discussion on the report of council was continued, and by-laws numbers 45 and 46 were ratified. Under motions, the papers on "Unrecorded Original Field Notes," by J. J. Murphy, and "Lake Erie Survey," by Otto J. Klotz, also the report of the committee on drainage, were taken as read, and ordered to be printed in the report.

Since the date of the meeting the balloting for the election of officers for the ensuing year has resulted as follows:—

President—P. S. Gibson, elected by acclamation.
Vice-President—H. J. Bowman "
Sec.-Treas.—T. G. Van Nostrand "
For Council of Management—F. L. Foster and J. L. Morris.

The report of the committee appointed to confer with representatives of the Can. Soc. C.E., was presented by Major Sankey. A cordial vote of thanks was tendered the retiring president for the manner in which the duties of that office had been fulfilled by him, after which the meeting adjourned.

The Hess Metallic Furniture Company, Niagara Falls, Ont., has begun building and will probably be the first company to use electric power developed on the Canadian side of the river for manufacturing purposes.

MANUFACTURE AND USE OF SAND CEMENT.

The following extract from a paper by C. B. Smith, McGill University, Montreal, was read by the author at the recent meeting of the Canadian Society of Civil Engineers in Montreal:

The use of sand cement has increased in Europe, and particularly in Denmark (where it was invented), during the past five years, and it has been tested by several American engineers, with satisfactory results, and has been used in the proportions (1 to 1) to 3, in the concrete for the foundations of St. John's Cathedral, New York, in which 3,000 yards were used, and in other places.

The advantages claimed for the material are, that where great strength is not required, mortars will be more dense, stronger, and will work more smoothly on the trowel, in which a portion of the sand has been ground together with the cement, before use in the mortar. Another claim is that the cheaper grades will replace lime mortar in plastering, as it will set and dry quicker, and also, again, that in dock walls a very dense concrete can be produced which will prevent the destructive percolation of sea water.

Tests made at St. John's Cathedral foundations gave the following results:—

(1) Sand cement (1 to 1) Concrete. 2 sand, 3 gravel — Compression. 1 week—2,144 lbs. per sq. in. 2 weeks—2,312 lbs. per sq. in. 4 weeks—2,588 lbs. per sq in.

(2) Sand cement Mortar. (1 to 1) sand cement. 3 sand. — 1 week's tension 156 lbs. 2 weeks' tension 188 lbs. 4 weeks' tension 200 lbs.

(3) Portland cement. 1 cement. Mortar, 1,500 bbls. 3 sand. — 1 week's tension 137 lbs. 2 weeks' tension 170 lbs. 4 weeks' tension 179 lbs.

The paper concluded with a description of the plant at Glen Falls, N Y., where tube mills and flint pebble balls are used in grinding, and a statement that the American sand-cement output is ground very fine (5 per cent. residue on 180 mesh sieve), the tests will show higher results than those in the table which is added, giving tests made in Europe on sand cement mortars of various proportions.

The usual proportions in America are (1 to 1) and (1 to 6), the former competing with Portland cement and the latter with lime.

(The manufacture of sand cement has been begun in Canada by the Rathbun Co., of Napanee Mills, and the St. Lawrence Cement Co., of Montreal.)

EXTRACT FROM EUROPEAN TESTS IN GERMANY AND DENMARK.

TENSILE (WATER).

Mortar.	1 wk. lbs.	4 wks.	3 mos.	6 mos.	1 year.
(1 to 2) to 2.....	142	242	299	384	400
(1 to 3) to 2.....	114	185	228	271	326
(1 to 6) to 2.....	57	114	156	..	220
(1 to 12) to 2.....	43	114	128	157	142
(1 to 24) to 2.....	28	57	57	57	57

COMPRESSIVE (WATER).

Mortar.	1 wk. lbs.	4 wks.	3 mos.	6 mos.	1 year.
(1 to 2) to 2.....	1,080	1,795	2,148	2,578	3,365
(1 to 3) to 2.....	497	1,080	1,637	2,008	2,485
(1 to 6) to 2.....	200	384	667	....	1,050
(1 to 12) to 2.....	171	384	726	796	866
(1 to 24) to 2.. ...	128	270	370	370	383

TESTS ON SAND CEMENT.

MADE IN M'GILL COLLEGE LABORATORIES.

(*a*) (1) Iron clad brand Orlen Falls (1) Sand:—

Neat.	Tension. 1 wk.	4 wks.	Compression. 1 wk.	4 wks.
	475	602	3,380	4,650
(1 to 1) to 3....	73	105 pressed.		
(1 to 1) to 3....	..	185 rammed.	1,060	1,120 rammed.

Blowing test good residue 1.5 % on No. 100 sieve.

(*b*) (1) Aalborg, Denmark. 1 Sand (Cathedral brand).

(1 to 1) to 1	279	398	1375	2012
(1 to 1) to 3	44	66	..	300

This is from a barrel which was supposed to be damaged.
Residue 1.2% on No. 120 sieve. 0.7% on 100 sieve.
" 18.0 % " 180 "

(*c*) (1) Star (Rathbun). 1 Sand (Ensign brand). 4 months, 800 lbs.

Neat.	1 wk.	2 wks.	1 wk.	2 wks.
(1 to 1) to 3..	66	95 pressed.	..	400 pressed.
(1 to 1) to 3..	183	192 rammed.	..	880 rammed.

Residue 0.6% on 100 sieve.
" 1.0% on 120 "

(1) Star (Rathbun). 6 Sand (Jubilee brand).
4 months, 340 lbs.

Neat.	1 wk.	2 wks.	1 wk.	2 wks.
(1 to 6) to 1..	213	230 pressed.	..	1350 pressed.
(1 to 6) to 1..	242	292 rammed.	..	2112 rammed.
(1 to 6) to 2..	184	215 "	1225	.. "

0.3% residue on No. 100 sieve.
1 3% " " 120 "

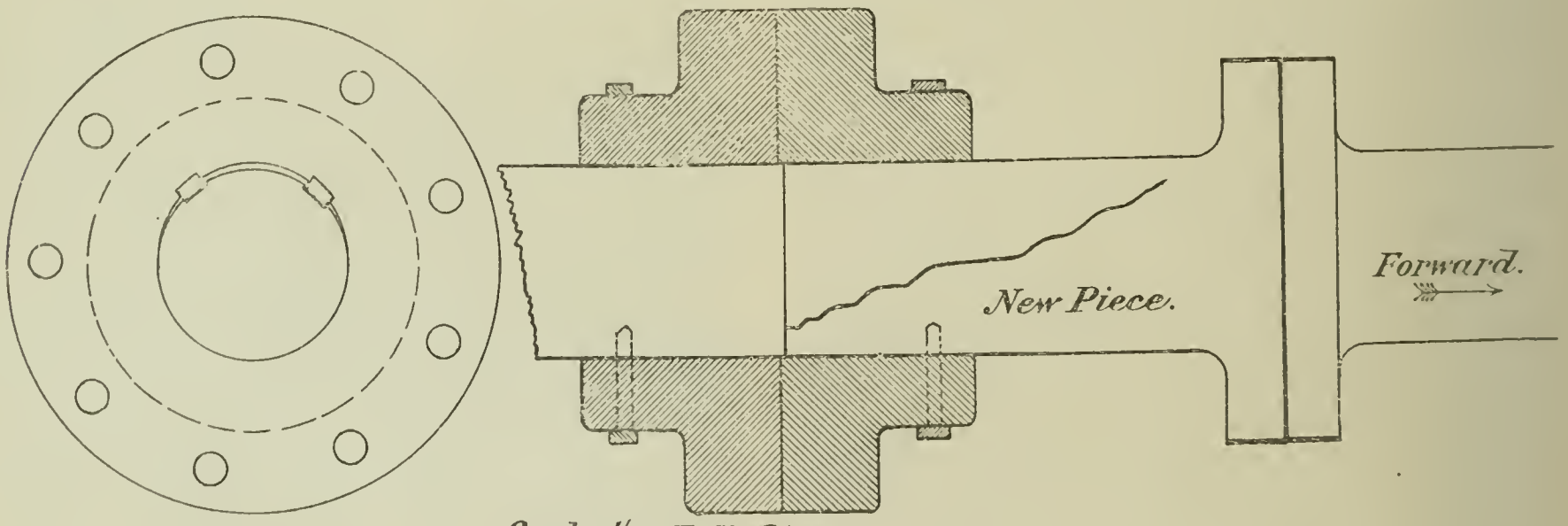
(1) Star (Rathbun). 1 Sand (Citadel brand).

	Tension.		Compression.	
Neat.	1 wk.	4 wks.	1 wk.	4 wks.
(1 to 1).....	332	475	1800 (?)	3837
(1 to 1) to 3..	135	141 rammed.	470	687 rammed.

0.2% residue on 100 sieve.
0.5% " 120 "

REPAIRS TO S. S. MONARCH.

The accompanying sketch illustrates the method devised by Wm. Golding, consulting engineer to Lloyds Surveyors, at the port of New Orleans, L. A., for repairing the fractured shaft of the steamship Monarch, which vessel cleared from that port on the 25th of November last, for Liverpool, carrying one of the largest cargoes ever taken from an American port, consisting of 22,535 bales of cotton: 60,000 bushels of grain; 11,200 sacks of meal; 29,068 staves and 242 head of cattle. Soon after sailing, a fracture developed in one of the 8 sections of the tunnel shaft, necessitating the return of the vessel to New Orleans, where she arrived without assistance on the 30th of November, 1897. To renew and remove the shaft would require several weeks' time, necessitating the removal of a large portion of the large cargo. It was therefore decided in the interest of all concerned, to repair the shaft in place, and make the renewal at port of destination.



Scale 1/16 Full Size.

As shown in the sketch, the shaft was cut off in place, while the vessel lay at anchor in the river; the new piece was forged, turned and fitted; the large coupling cast, bored and turned, and the entire work completed in less than 12 days after the vessel's return; the success of the undertaking is attested by the arrival of the vessel in due time, at port of destination. The value of vessel and cargo was estimated to be $1,250,000.00.

PROSPECTOR'S OUTFIT.

Editor CANADIAN ENGINEER:

A frend of mine who intends to go prospecting before long through the Omenica district, asks if it would be advisable to take an inexpensive outfit for testing ores, with a suitable textbook on same.] He knows nothing whatever of analysis or assaying. Will you kindly give me your opinion on the matter, and if you think it would be judicious for him to take an outfit such as mentioned above, what would it need to consist of and what work on the matter would you recommend as the most suitable, that is to say, the simplest and most practical? By giving information asked for you will greatly oblige

Yours truly,
SUBSCRIBER.

British Columbia Southern Railway,
Wardnor, B.C., 5th April, 1898.

[ED.—We would advise your friend to secure a copy of either "Gold and Silver Ores," by W. Hamilton Merritt, or "Pocket Mining Manual," by J. H. Chewett, both of which will be found in the book list on page III. of this paper. The following is a list of articles required for field work, it being taken for granted that the prospector is already in possession of a rough knife for scratching minerals, a pocket compass and a small magnifying glass:—

Sampling—1. "Mixing cloth," or smooth waterproof sheet, 4 feet square. 2. Brush, broad (varnishing brush). Panning—3. Gold-pan, Russia iron (not to be used with quicksilver) 4. Iron mortar, 5 in. by 6 in., and pestle. 5. Sieve, brass wire, 40 mesh, in tin dish with cover. Pan-Amalgamation.—6. Two gold pans, one ordinary iron, the other graniteware. 7. Nitric acid, strong, in 2 oz. glass-stoppered bottle. 8. Mercury, 1 lb. in bottle. 9. Sodium, 1/8 oz. in bottle, with naphtha. 10. Hand-scale, "Traveler's letter and parcel balance," weighing 1/4 oz. to 12 ozs., for weighing mercury and pulp. 11. Balance, hand scale with sliding weight on beam, very sensitive, from 0.1 to 5 grains, for weighing beads of bullion and weighing out charges for quantitative blow-pipe assay. 12. Mercury retort, small, Russia sheet-iron 1 1/2 x 1 3/4 inches, or small cast iron retort, with cover and pipe to collect mercury. Also sheet of Russia iron 8 inches square (with hole for supporting the Russia iron retort in the centre) for quartering when sampling. 13. Porcelain dish, and porcelain thimble, small, for parting in. 14. Graniteware cup and saucer, small size. 15. Brass wire sieve, 60 mesh. 16. Wooden pestle. 17. Sheet lead, pure, 2 ozs. 18. Sheet silver, pure, 1/8 oz. 19. Borax glass, ground, 1 oz., in deep round tin box. 20. Soda, 1 oz, in deep round tin box. 21. Litharge, 4 ozs., in deep round tin box. 22 Bone-ash, 2 ozs., in deep round tin box. 23. Paraffine lamp, tin, with 1/8 lb. paraffine. 24. Blow-pipe. 25. Two clay pipes, one mounted for cupelling, the other for heating mercury. 26. Charcoal, 3 pieces, sawn square. 27. Pincers for small buttons. 28. Steel anvil, 1/4 x 1 1/2 x 2 inches. 29. Small piece thin asbestos card. 30. Hammer, small 31. Magnet. 32. Smooth-headed bolt, for making cupels in clay pipe This outfit will determine the value of free milling ores as low as of any economic value; it will enable the proportionate yield in concentrates to be qualitatively tested as to their precious metal contents. Quantitative determination of concentrates outfit. 33 Plattner's ivory button scale. 34 Clay crucibles, 1 doz. 35. Clay capsules, 2 doz. 36. Fletcher's blow-pipe furnace with side hole. 37 Camel-hair brush. 38. Flour, 1/4 oz (?) in tin box. 39. Methylated spirits 1/4 pint. 40. Common salt, fine, 1/2 oz, in tin box 41 Nitre, 1/2 oz, in tin box. 42. Spirit lamp, tin. With the above mentioned outfit free-milling ores can be tested, and value determined as low as $1 50 per ton for gold ores, and much lower for silver ores, if desired Also the value of the concentrates, or of melting silver ores, can be approximately estimated. The weight of the outfit is about 20 lbs.]

CO-OPERATIVE SETTLEMENT.

Editor CANADIAN ENGINEER:

SIR,—The prospect of early work on the Georgian Bay and Ottawa Ship Canal, together with the agitation for a railway to James' Bay, give point to a suggestion I made regarding a co-operative settlement by men of intelligence and some financial means. I know a point where these enterprises must intersect, if the shortest route, with the best land adjacent, are considered important. The shore of the Georgian Bay is rockbound round the north, and admission must be sought where a bay or navigable river penetrates the coast range of granite or Huronian mountains. Spanish River, Parry Sound, Cutler and Thessalon, are examples of such entrances; while French River, White Fish, Blind and Mississagrea Rivers are barred by falls at their mouths. Now a navigable bay, penetrating to the arable land, and accessible in all weathers, is a very desirable point from which to start a colonization road. If, in addition, unlimited water power, cheaply controlled, be added, with a choice of routes through good country for

50 miles to form a Hinterland, then I hold an ideal location will be selected. The port and settlement would be on Laurentian territory, with iron, mica, granite, galena and gold, as minerals to be expected; its rear would be the contact with Huronian, on the same lines as the Wahnapitae gold formation. The probabilities would amount almost to a certainty, that paying mines would be one of the assets of the colony; that the port would be a distributing point on the James Bay railway; and that a good farming background would give stability and weight to the commercial, manufacturing and mining features of the enterprise.

As suggested before, an electric railway to progress with the onward wave of settlement, should be a prominent feature. Supposing Sudbury to be the first objective point on the James Bay route, our line would run obliquely to N. E. of it, and act as an auxiliary rather than a rival. While the first cut of pine has been taken off the district, the hardwood, pulp timber and bark is yet untouched, and might amount to a valuable consideration. A company with, say, 1,000 shares of $100 each, to be sold at par only, and employing only shareholders (if enough offer) to do the work; with no speculators, and no drones; with a store at which all supplies are furnished at cost; and with all mechanical appliances furnished by the members at special rates; with electric light, power, carriage, and even board, at rates to meet actual outlay, the conditions of settlement would be so much superior to the general conditions of pioneers that colonization would be shorn of its chief discomforts. If you could leave the crowded streets, vile odors, competitive battle, dress parade, and taxes of city life; but carrying school, church, library, literary and musical socials with you, into a healthier climate, with more profitable employment, abundant fuel, fruit and flowers—in short a natural life—who would hesitate to embark in it? You cannot choose your company in city life—you may in the country.

HOMO SENEX.

THE DOMINION ESTIMATES.

RAILWAYS.

Intercolonial Railway—		
Sundry improvements	$280,600	
Extension to Montreal, to pay rental to Grand Trunk Railway Company for railway from Chaudiere to Montreal, to be operated as part of the Intercolonial Railway	210,000	
		$490,600
Prince Edward Island Railway—		
Improvements		18,500

CANALS.

Soulanges Canal—Construction	1,610,000
Cornwall " enlargement	160,000
Farran's Point "	325,000
Rapide Plat "	250,000
North Channel, straightening and deepening	50,000
Galops "	1,275,00
River Reaches	50,000
Lake St. Francis, removal of boulders, etc.	50,000
Trent	603,200
Sault Ste. Marie—Construction	45,000
Lachine	155,000
Lake St. Louis Channel, straightening and deepening	65,000
Grenville—Enlargement	40,000
Williamsburg Canals	9,000
Murrray Canal	1,000
Rideau "	875

HARBORS.

Nova Scotia—	
Various wharves and breakwaters	38,900
Prince Edward Island—	
Piers, wharves, etc.	40,650
New Brunswick—	
Wharves, dredging, etc.	43 200
Quebec—	
Piers, breakwaters, wharves, dredging, etc.	97,700
Ontario—	
Wharves, dredging and piers	234,200
Manitoba—	
Repairs, improvements, etc.	28,000
North-West Territories—	
River and bridge work	5,000
British Columbia—	
Improvement of channels, etc.	51,500

PUBLIC BUILDINGS.

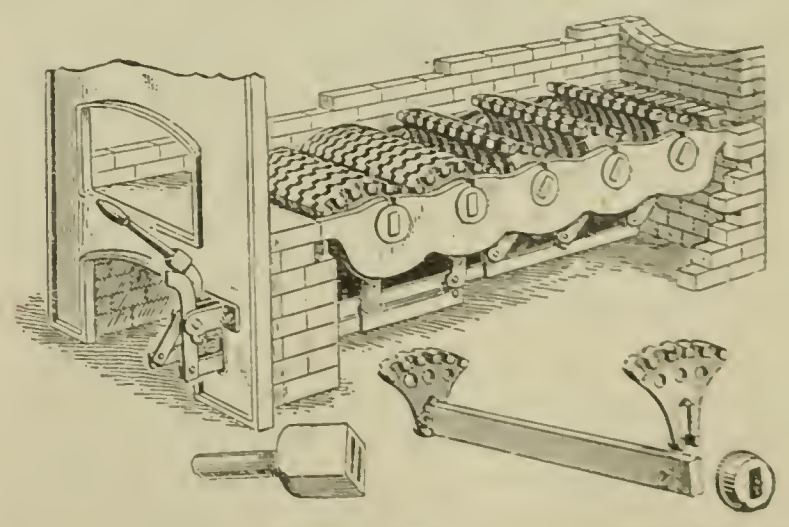
Nova Scotia—	
Halifax drill hall	18,000
Kentville public building	5,000
Liverpool "	5,000
Ontario—	
Kingston drill hall	10,000
Sarnia public buildings	5 000
Manitoba	
Portage La Prairie post-office	8,000
British Columbia	
Victoria public buildings	16,000

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The eleventh annual dinner of Hamilton No. 2, C A S E., was held in the Commercial Hotel, April 7th. There was the usual large attendance, and the evening passed most pleasantly. The menu was excellent, and was done full justice to before the toast list was presented by the chairman, R. Mackie. During the evening music was interspersed by Messrs. Jardine, the Eleon Club, J. R. Dixon, Stanley, Hastings, A. Child, W. G. Blackgrove, F. Mitchell, and D. Marentell. J. Bain acted as accompanist. The dinner committee was R. Mackie, chairman; Joseph Ironside, secretary; P. Stott, W. R. Cornish, W. Stevens, R. E. Chillman, R. C. Pettigrew. The toast list was as follows: The Queen; Canada our Home, responded to by A. Hartwell; Mayor and Corporation, responded to by Alds. Hernside and Pettigrew; Manufacturers, responded to by J. McGlauchlin, of Toronto; Educational Interests, responded to by J. S. Williams; Executive Head, responded to by E. J. Philip, A. M. Wickens, of Toronto; Sister Associations, responded to by Messrs. Mooring and Dixon, of Toronto; Hamilton No. 2, responded to by R. Mackie; The Ladies, responded to by A. P. St. John; Host and Hostess, responded to by Messrs Moxey. A pleasant feature of the evening was several selections by the gramaphone, operated by Mr. Morrice.

ROBERTSON'S SHAKING AND DUMPING GRATE BARS

The shaking and dumping grate bars of which the accompanying engraving gives an idea are manufactured by Jas. L. Robertson & Sons, 204 Fulton St., New York, who are successors to the Heine & Robertson Co. The firm is very favorably known to the trade, not only in the United States, but in Canada as well. The makers state that nearly seven years use,



under conditions of unusual severity, has demonstrated their efficiency and durability, and the recent changes in design, tending to greater strength, enable them to promise even more satisfaction in the future. The grate is composed of a series of replaceable leaf castings, a best quality wrought iron cross bar, protected from the heat, and durable bearings in which, it is claimed, friction is reduced to a minimum. Frames for seven sections and under are made without truss.

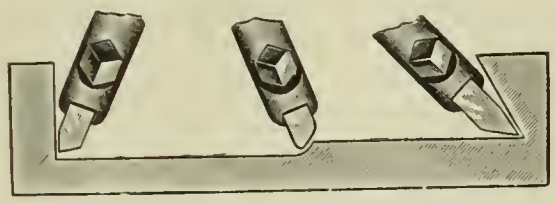
L'ASSOCIATION DE SECOURS MUTUELS DES INGENIEURS MECANICIENS.

This association held its annual meeting on the 25th ult. under the presidency of Ephrem Valiquet. Associated with him were Louis Gayon, Factory Inspector; Alex. Bonin, Prof. at Laval University; J. A. Rodier, and the association's legal adviser. The election of officers resulted as follows: President, Ephrem Valiquet; 1st Vice-pres., Henri Beauchamp; 2nd Vice-pres., Mathis Guimond; Treas., Wm. Gendron; Fin. Sec., Eteinne Leroyer; Corresponding Secretary, Alex. Blair; Asst. Sec., Jos. Guimond; Trustees, Magnus Lessard, Arthur Coulombe, Alphonse Provost; Conductor, Arthur Alix; Doorkeeper, Telesphore Leclaire; Employment Agent, Ephrem Valiquet; Delegates, Gendron, Denis, Coulombe. After the

elections many good speeches were made, tending to emphasize the fact that the objects of the association were mutual benefit and improvement, not what is understood as labor organization in any form.

INTERESTING TO LATHE OWNERS.

A practical substitute, of self-hardening steel, for forged tools for general lathe and planer work, especially adapted for economical use, is shown in the accompanying cuts. These tools possess, the makers claim, all the good points of a forged

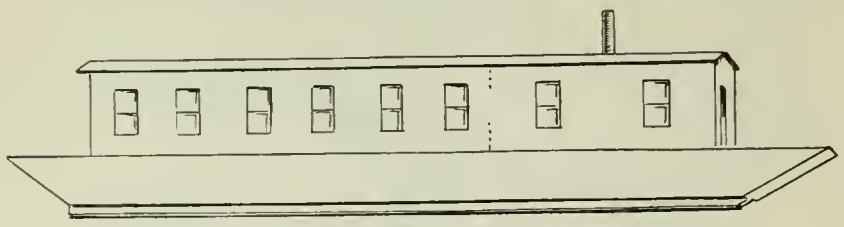


tool, and are made in variety of sizes in straight right and left hand offset, and in the form of a boring bar. The makers claim a saving of 90 per cent. tool steel, that is, one pound of steel used in a holder will do the work of 10 lbs. used in the old way, and also a saving of 70 per cent. in grinding. The Goldie-McCulloch Co., McClary Mfg. Co., Toronto Electric Motor

Co., Bertram & Sons, J. J. Stevens, and many other leading Canadian manufacturers, have adopted these tool holders. Further information can be obtained from the Aikenhead Hardware Co., Toronto.

AN OTTAWA RIVER HOUSE BOAT.

Bannerman & Findlater, manufacturers of boilers, etc., Ottawa, who recently moved into their new premises, which were rebuilt on a larger scale after the fire of last year, have recently turned out an interesting job in the shape of four lumbermen's "house boats," for the Upper Ottawa Improvement Co. These are the first iron house boats built in Canada, two of them being for use at Quio (Chats Lake), and two on the Ottawa, at Pembroke. These boats—a diagram of which is given herewith—are scow-shaped, each 5½ feet long over all, with a keel of about 42 feet; 12 feet wide at the top, and 11 feet



across the bottom and 3 feet deep. The bow tapers to an extent of about 6 feet, and the stern 4 feet. The keel is formed of a piece of timber 7 inches deep and 6 inches wide, and is protected by an iron shoe. The house stands 6 feet above the top of the hull, making a height of ceiling of about 9 feet. The kitchen and cabin occupies about one-third of the house, the rest being occupied by sleeping berths, of which there are two tiers, a tier on each side of the boat with a gangway through the middle, making accommodation for a crew of twenty-four. The house is clap-boarded with an iron roof.

NEW PLANT FOR THE WAR EAGLE MINES.

The War Eagle Cons. Mining & Dev. Co., of Rossland, B.C., have just closed a contract with the James Cooper Mfg. Co., Limited, Montreal, for a Duplex Ingersoll-Sergeant Air Compressor, and a 300 horse power Electric Hoisting Engine. The compressor is a Duplex machine of the latest type having two 24¼" by 48" air cylinders, and is ample at normal speed to furnish sufficient air for 50 drills. It will be operated by a 500 horse power motor, and in place of belting, 22 cotton ropes will be used to drive the machine. As an evidence of the size of this machine, it may be stated that the fly wheel is 20 feet in diameter and will weigh, when finished, about 25 tons. Mr. Mills, the Consulting Mechanical Engineer for Mr. Gooderham, after an extended tour through the mining districts of Montana, California and British Columbia, and after making exhaustive tests of the efficiency of the various types of compressors, decided to adopt the piston inlet type of machine as being the most economical. The hoisting engine, which is to be operated by electricity, is of 300 horse power, and has double drums arranged for two-compartment shaft, and is capable of hoisting from a depth of 3,000 feet, the normal working load being 8 tons, and the speed 1,000 ft. per minute. The motor for the hoisting engine is of the induction type, and can work up to 600 h.p. It is reversible and can run at any speed up to synchronism. Not only will the compressor be the largest machine ever built in Canada, but both the compressor and hoisting engine will be the largest machines on this continent operated by electricity, and it speaks well for the enterprise of Rossland mines, that they are foremost in the field of up-to-date machinery. The motor for the compressor is a 400 h.p. synchronous machine and will run at 200 revolutions per minute. The electrical equipment is being furnished by the Canadian General Electric Co., of Peterboro, Ont., and the machinery when completed will aggregate about 15 carloads. The plant is to be delivered on cars in ten weeks from receipt of order, and should be on the ground inside of three months. The power will be derived from the works of the West Kootenay Power Co. The War Eagle mine has now been proved to a depth of 625 feet, giving an estimated amount of ore in sight of $3,500-000. In one place the vein is exposed to a width of 50 feet, giving an average assay of $25. The force of miners is to be increased to 50 men.

CANADIAN ELECTRICAL ASSOCIATION.

At the last meeting of the Executive Committee of the Canadian Electrical Association, it was decided to hold the convention on Tuesday, Wednesday and Thursday, the 28th, 29th and 30th of June, in Montreal. The headquarters of the association during the convention will be at the Windsor Hotel, where the business sessions and the annual banquet will be held. The draft programme, recommended by the local committee of arrangements, with some slight amendments, was adopted, and is as follows:

First Day.—Executive meeting 9.30 to 10 a.m.; session, 10 a.m. to 1 p.m.; session 2 to 5 p.m.; 7.30 p.m., trip round Mount Royal by special Park and Island cars, afterwards ascending Incline railway, to lookout on mountain to view the city under illumination.

Second Day.—Session, 9 to 12, noon; cabs and busses from Windsor Hotel at 1 p.m. to visit: (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Co., returning to city at 7.30 p.m.; 9 p.m. annual banquet of Association at Windsor Hotel.

Third Day.—Session, 9 to 12 a.m., election of officers and visit to McGill University; 1.30 p.m., visit to Royal Electric Company's lighting station and factory, then by special G.T. train to visit the works of the Chambly Manufacturing Company at Chambly.

A number of very interesting and instructive papers relating to various phases of electrical work have been promised and are in course of preparation. Negotiations are in progress with the object of securing special transportation rates to enable a large number of the western members to participate in the proceedings of what will undoubtedly be a very pleasurable and instructive occasion.

THE E. & D. WHEEL.

The factory of the Canadian Typograph Co., manufacturers of the celebrated "E. & D." bicycle, is pushed to its full capacity. The Globe, in a recent notice of this wheel, says: "The bearings of this bicycle were invented in Canada in 1895, by Canadians, and the wheel is built only in Canada and exported throughout the world. It is the first and only Canadian bicycle that has successfully entered the United States market, and Canadians have a particular reason for feeling proud when it is known that this wheel commands a higher price than any wheel in the United States, and that it is sold there at an advance of from $15 to $20 above its price in Canada. Perfection of movement has always been the particular theme of this company, and they have every reason to feel proud of the reputation they have gained in so short a time by their wonderful hub. We are in-

formed that they have never yet supplied a cone or ball for this bearing, nor ever been asked to replace one. They defy their competitors or others to show a cone out of their wheel, no matter how long it may have been in use, that shows the slightest indication of wear. They also challenge the public to destroy one of their bearings or to make it bind, no matter how tight it may be screwed up. The wheel is guaranteed to run the year without being oiled or cleaned, no matter how many miles it is ridden, or how much dirt is encountered. The bearings also are guaranteed against wear for three years. They never require to be adjusted or interfered with. The Typograph Company has a special model this year, which includes the Doolittle automatic brake. Simple back pedalling applies the brake, and when once applied, the foot can be removed and the brake remains, while forward pedalling immediately releases the brake, so that the rider has complete control of his wheel, whether his foot is on the pedal or not. This model also includes a new gear case, composed of aluminium and celluloid. It can easily be removed and leaves the chain and sprockets at all times exposed to view. It is also so arranged that the back wheel can be adjusted without in any way disturbing the case.

BOILER EXPLOSION AT ORILLIA.

The boiler at Miller's tannery, Orillia, Ont., exploded on Good Friday evening, wrecking the building and causing damage to the extent of over $5,000. At the close of the holiday, the fireman, thinking to get an early start in the morning, filled the furnace with wood ready for lighting and in that condition left the place. It is supposed the wood took fire from the heat of the bricks from the previous firing, and that the safety valve had become stuck, preventing any release of steam. An idea of the wreck may be gained from the accompanying illustration. Two fragments of the boiler narrowly missed a train passing at the time. The crown of the boiler went through a barn a great distance from the scene, and the angle at which it struck

the building showed that it must have been thrown at least half a mile high. In view of the terrible treatment received by the crown, at the hands of the steam fury, it is remarkable how gently it handled the window sash shown in the left foreground of the picture. This sash was used as a skylight, and was fixed in the roof right over the boiler. This sash was found after the explosion in the position shown, with not a single pane of glass broken. The mere concussion of air broke the glass in several houses near by, and how this window sash with all its contents passed through the explosion unshattered is a phenomenon. One theory is that it was lifted as on a cushion of steam, and so let down flat to the ground. Even so, its safe descent is remarkable, and how it was torn out of its frame, in the first place, without breaking the glass, is still more remarkable.

It is decided that Agincourt is to be the location of the instrument of the Magnetic Observatory now in the Queen's Park, Toronto. William Menzies will be in charge. The building to be erected will consist of a circular stone underground chamber of some 30 feet in diameter, topped by a brick structure for the making of absolute determinations. In the underground room, the needles of vertical force, horizontal force and the declinator will make photographic records of the earth's magnetic currents. The new building, it is estimated, will cost in the neighborhood of $4,000, and that the utmost care will be exercised in its erection can be seen from the fact that every stone put in the walls must be tested to ascertain that it contains no iron to disturb the delicate working of the magnetic instruments within.

Industrial Notes.

Belleville, Ont., will buy a road roller.

The new high school, at Fergus, Ont., will probably cost $5,000.

St. Thomas, Ont., will spend $36,000 on school buildings this summer.

The town of St. Cunegonde, Que., wants another bridge over the Lachine Canal.

Tenders are called for the Victoria Hospital, London, Ont., which is to cost $70,000.

A Y.M.C.A. building, to cost $6,000, is to be built in St. Catharines this summer.

Knox Church, Stratford, Ont., is to be altered and remodelled at a cost of $7,000.

R. F. Watts, Ottawa, Ont., is said to have invented a new roller boat which is rectangular in shape.

Sarnia, Ont., proposes to bonus a paving brick manufactory which would use shale from Alvinston, Ont.

Sheldon & Son, of the Aylmer, Ont., Iron Works, have received a large order for windmills from Australia.

J. Bloom, who ran a sawmill at North Glencoe, Ont., was killed by falling on the circular saw, March 31st.

The I.O.O.F. will build a town hall in Essex, Ont., one flat of which is to be leased by the town at $300 per year.

Lefebvre & Co., St. John's, Que., are putting an acetylene gas machine into their vinegar and canning factory.

Park, Blackwell & Co., Toronto, have decided to erect a new pork packing establishment. It will cost $100,000.

The city engineer of London, Ont., has proposed a dyke to surround the suburb of West London at a cost of $150,000.

The pumping plant at the high level reservoir, Montreal, requires a new large high duty pump, which will cost about $70,000.

The contract for the new Verity Company's buildings, Brantford, Ont., was let to Havill & Whitham, Brantford, for $50,750.

S. S. Jewett & Co., brass founders, Buffalo, N.Y., have no intention of establishing a brass foundry at St. Thomas, Ont., at present.

Ridgetown wants W. E. Hall's furniture factory to move there from Galt. It has been offered a bonus and exemption from taxation.

The Simpson-Merner Furniture Co., Berlin, Ont., of which Senator Merner is the head, will erect a large addition to its works this summer.

Extensive improvements are to be made in St. Andrew's Church, Perth, during the coming summer. It is estimated that $10,000 will be expended.

The Sarnia Gas & Electric Light Co. has closed a contract for a modern gas producing plant, with the Western Gas Construction Co., of Fort Wayne, Ind.

E. F. Head, architect, Rat Portage, Ont., has been instructed by the school board to prepare plans and specifications for a twelve room school building.

J. E. Belcher, C.E., County Engineer, Peterboro, Ont., has prepared plans for the Mudlake bridge, partly embankment and partly floating, to cost $25,000.

J. W. Meyers & Co., Listowel, Ont., have decided to make $7,000 improvements to their flour mill. They will also build an elevator, 30 x 48 feet, this summer.

The incorporators of the Dominion Aluminum Roofing Company, Montreal, are: Abel Huot, Lucien Girard, Antoine Collard and Nap. Plessis, contractors.

The Leviathian Belting Co., Boston, Mass., has opened an office in Quebec, at No. 101 St. John St., and has appointed L. H. Gaudrey as its representative in the district.

At Hartland, N.B., it has been decided to form a joint stock company to build a bridge. The government will be asked to guarantee the bonds for a term of 15 years.

Another pulp mill is to be built on the Sissaboo River, near Weymouth, N.S., as the Fredericton Reporter notes that a new company has been organized for the purpose.

The Ottawa Board of Trade has taken action that may soon lead to the establishment of a Technical School, in order to encourage the manufacturing industries of the city.

The Metallic Roofing Co., Toronto, has just supplied one of their metal ceilings for the chapel of the Central Prison. These goods are particularly adapted for church work.

The Rat Portage Lumber Co., of Rat Portage, Ont., is expending in the neighborhood of thirteen thousand dollars in special improvements on its planing mill, saw-mill, etc.

The London, Ont., water commissioners have decided to continue the conduit to Byron, so as to tap Griffith's springs, which will add 250,000 gallons per day to the city's water supply.

Two spans of the Saskatoon bridge on Qu'Appelle, Long Lake and Saskatchewan Railway, were carried away by ice April 19th. In the meantime crossing will be effected by ferry.

Dartmouth, N.S., has a proposition before it to bonus a pulp mill to have a capacity of 20 tons per day. The promoters have secured options on suitable water power and land in the town.

The Donoghue Bros., Kingston, will erect, on their property, near the Montreal Transportation Company's elevator, a grain elevator with a capacity of between 80,000 and 90,000 bushels.

M. A. Cleveland, who has a contract on the public works, Cardinal, is now starting in on his rock work, after placing an order with this same company for one of their latest model Sergeant drills.

F. G. B. Allen, supt. of the Cement works at Napanee Mills, Ont., has fitted up a laboratory in his residence. The office has also been moved to the station, the old office and laboratory turned into an engine room.

Some Ottawa people are looking for a suitable location and water power, to build a large pulp mill. If suitable site can be secured, with good shipping facilities, building operations will be commenced early this summer.

The respective county authorities of Norfolk and Simcoe, Ont., have decided to recommend that a new steel bridge, 150 feet long, be constructed over the Big Otter Creek, between the townships of Bayham and Middleton.

A man who has large experience in steel and iron manufacture, is coming out from England to take hold of Thos. Doherty's latest invention in that line, and will remain in Canada a couple of months at least, it is said.

The Manufacturers' Committee of the Brantford City Council propose a general exemption from all but school taxes, upon all machinery and tools for local manufacturing industries, employing a given number of hands.

The McClary Manufacturing Company, London, Ont., is filling an order from a San Francisco house for $7,000 worth of stoves, tin and graniteware, for the Yukon trade. The goods, which will fill six cars, will be shipped direct from London.

The Niagara Falls Metallic Furniture Company, Limited, has been incorporated with a capital of $24,000. The officers are as follows: Pres., R. P. Slater; Vice-pres., W. Phillips; Sec., J. E. Stephenson; Treas., Dr. E. T. Kelliham; Manager, Wm. Hess.

W. Harris, Day's Mills, Algoma, Ont., offers power and mill-site free, with small bonus, to any responsible party who will erect any kind of wood-working, furniture or handle factory. Any amount of good hard wood and other timber near the site.

John F. Stewart, for many years manager of the James Stewart Manufacturing Company, Woodstock, has been succeeded by his brother, Adam A. Stewart. J. F. Stewart still retains his interest in the business, and the presidency of the company.

The James Cooper Mfg. Co., Limited, Montreal, has just completed shipment for Larkin & Sangster, contractors, Iroquois, Ont., of four Lidgerwood double cylinder, double drum hoisting engines, with five Sergeant drills, and quarry bar outfit.

The molders in the Waterloo Mfg. Co.'s foundry, struck recently for an advance of 25 cents per day; as no notice was given the management of dissatisfaction beforehand, the strikers did not receive any consideration, but were replaced by outside labor at once.

J. Zryd, G. Zryd, O. Zryd, J. E. Schmidt, Annie M. Zryd, Hespeler, Ont., have been incorporated as the Zryd Gas Machine Company, of Hespeler, Limited, to manufacture, buy, sell and deal in acetylene gas machines and parts thereof, capital, $5,000.

The village of Andover, N.B., has been recently incorporated and proposes to put in a fire protective waterworks system of 2¼ miles of piping. C. L. B. Miles, C.E., has been engaged to make the necessary surveys and plans. Tenders will be shortly called for.

L. McGlashan, manager of the Ontario Silver Works, Humberstone, Ont., intends making a large addition to the factory. The new wing will be about 100 x 40, brick. A large dynamo and gas engine will be among the plant to be placed in the new addition.

The Council of Westmount, Que., have passed the by-law authorizing the loan of $350,000, to be used in the construction of parks and other public improvements, among which are a contagious disease hospital to cost $15,000, a dump and incinerator to cost $10,000, and municipal buildings, $25,000.

The People's Heat & Light Co., of Halifax, is increasing their plant for greater facility in handling materials at the power house, and has placed an order with the James Cooper Mfg. Co., Montreal, for a standard Lidgerwood 30 horse power link motion and friction double drum cylinder hoisting engine, which will be shipped at once.

Andrew Bell, C.E., Almonte, Ont., on behalf of a company, has asked the Carleton Place town council for a franchise to put in a system of waterworks similar to the one in Perth, Ont. He wants a similar franchise for Almonte, and the company he represents is said to be willing to spend $100,000 in each town to put in a first-class system of waterworks.

The following have obtained incorporation under the style of the Jacques Cartier Pulp Company, to carry on the business of pulp and paper manufacturing; acquire water powers on the Jacques Cartier river and elsewhere, develop electricity to be supplied for motor and lighting purposes, etc., etc.: E. Goff Penny, R. Archer, Wm. Strachan, W. Currie and R. Law, Montreal.

The dynamite factory of the Ottawa Powder Co., situated on the Chelsea Road, on the Quebec side of the river, about four miles north of Ottawa, was recently blown up. No person was injured or killed. The damage to the plate glass in Ottawa amounted to over $2,000. The cause of the explosion is not known. This is the third time that the factory of the Ottawa Powder Co. has been blown up.

The Wm. Hamilton Mfg. Co., Peterboro, has in hand the entire equipment of a sawmill, which the C.P.R. is erecting at Cool Creek, about 60 miles west of McLeod, N.W.T., in the Douglas Fir District. The equipment of the mill is of the most modern type, and it will have a capacity of 100,000 feet in ten hours. The entire plant comes from the Hamilton shops, including a battery of six boilers, handsaws, etc.

James E. Smith, who at the time of the Windsor, N.S., fire, had charge of the reed and rattan department of the Windsor Furniture Mfg. Co., has entered into a partnership with H. B. Murphy, of the firm of Wood & Murphy, and will commence manufacturing reed and rattan goods. The factory will be in Falmouth, N.S., near the mill of F. H. Manning, who is now erecting a building, and will supply the new firm with power, water, etc.

The Dominion Plumbing and Supply Association was formed in Montreal recently, letters calling the meeting being sent out by Geo. Booth, of Toronto. The object of the association is for the better protection of the trade. The officers elected were: J. Reid Wilson, Montreal, president; A. A. McMichael, Toronto, vice-president; W. H. Wiggs, Quebec, second vice-president; while the Executive Committee will be formed of Col. F. Massey, W. Greig, A. Lariviere, J. M. Taylor and H. Wright.

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The Ontario Board of Health recently approved the plans for the village of Hintonburg, which is putting in a system of sewage; for Mount Forest and Port Colborne, which are putting in waterworks; and Rat Portage, which is also constructing waterworks and extending its sewage system.

The James Cooper Mfg. Co., Limited, Montreal, has just secured an order for an additional plant for the Regina Gold Mine, Limited, of Rat Portage, consisting of duplex cross compound condensing Ingersoll-Sergeant piston inlet compressor, ten drills, battery of boilers, pumps, heaters and all necessary connections to install plant complete. The first shipment in this contract has now gone forward.

Thompson & Co., Sherbrooke, Que., have agreed to install, in Lennoxville, a system of waterworks. The water will be taken from Haskell Hill, about half a mile distant. The reservoir will have a capacity of 400,000 gallons, and will be about 125 feet above the town. The contract will have to be finished within eight months from the date of the signing of the contract. There are to be twenty hydrants placed in the streets for fire purposes. A number will be placed in and about the buildings and grounds of Bishop's College.

The James Cooper Mfg. Co., of Montreal, has completed shipment of contract for complete mining plant entered into with the Montreal-London G. & S. Dev. Co., to equip the Dufferin property, at Salmon River, N.S. This plant consists of a duplex cross-compound condensing Ingersoll-Sergeant piston inlet air compressor, eight drills, battery of three boilers, one 50 horse power and one 40 horse power Lidgerwood link motion and friction double compartment shaft hoisting engines and all necessary piping and connections to install plant complete ready for operation.

Some important experiments were recently made in the Workman Engineering Building, at McGill University, by Profs. Adams and Nicholson, of the Faculty of Applied Science. They consist of taking filings or turnings of brass, copper, tin and other metals, and by means of pressure, securing therefrom solid bars of metal, differing very little in appearance and strength from castings. The machine used in these experiments brings to bear upon the filings and shavings about 78,000 lbs. pressure to the square inch, and this has the effect of welding them into a solid bar of metal.

The Canadian Photo-Engraving Bureau is extending its premises, having leased another flat in the building in which it is located, at 16 Adelaide St. West, Toronto, and is now making extensive alterations and improvements in it. Part of this extra flat will be used as an office, giving them greatly increased accommodation, and the balance as a photo department. It is their intention to establish a first-class photograph department, fully equipped for all kinds of commercial photography, such as landscapes, buildings, interiors (daylight or flashlight), and articles of any kind. The combination of the photograph gallery with the photo-engraving business, is a good one, and will be a great advantage to those having cuts to be made, where the photos have to be taken from the article or building.

Prof. Callendar, who has just resigned from the staff of McGill University, has designed a platinum electrical resistance thermometer, capable of measuring temperature to the ten thousandth part of a degree. The extreme delicacy of the instrument makes it a valuable aid in securing accurate observations of the temperature of lake and river water, during the various seasons of the year, as no thermometer is available for such minute measurements. A long series of observations of the temperature of the St. Lawrence has been made this winter by the McGill professors, in all of which the new instrument has been used. By its aid it has been found that the greatest deviation that takes place in the winter during the ice-forming period, is only about one thousandth part of a degree. Prof. Callendar's invention is, undoubtedly, of great interest to the scientific world.

The Wm. Hamilton Mfg. Co., Peterboro, Ont., has recently completed the engines for a large stern-wheel steamer, for J. A. Mara, Vancouver, B.C. The wheel is 19 feet in diameter with buckets 9 feet long, which take a dip of 30 to 34 inches; on either side of the wheel the cranks are placed. The crank shaft is a steel forging 10 inches in diameter and 24 feet long. The engines are aft on each side. The boiler is placed well forward, about 70 feet from the engines. The engines run 30 revolutions per minute, and the boiler pressure will be 160 lbs. The power developed is calculated at 2,300 h.p. Speed, 18 miles per hour. The cylinders are 17 inch and 6 foot stroke. The connecting rods are 24 feet from crosshead to the crank pin, and are built up of plates. From the head of the cylinders to the outside of the paddle wheel will be 48 feet. The boiler is of the locomotive type, 62 inches in diameter, by 7 feet long. In the barrel are 212 inch tubes, 14 ft. long. The furnace is 7 ft. by 5 ft. by 6 ft. high inside. The Hamilton Company has now in hand a duplicate set of these engines, building to the order of the C.P.R., for one of their boats running from Vancouver to Fort Wrangel.

Of interest to engineers throughout Canada is the advent of a new company known as the Canadian Chemical Compound Co. The principal promoters are A. M. Wickens, E. J. Philip, D. J. LeRoy and Richard Jeffrey, all of Toronto. The new company will manufacture boiler compounds, of which it has three special brands, suited for waters of different character. As the public may well be sceptical of the virtues of a patent medicine which claims to cure all diseases, so engineers may doubt the efficacy of any one boiler compound which claims to be suitable for waters of every locality. The Canadian Chemical Compound Co. not only has three different brands suited to the waters of most localities in Canada, but they undertake in exceptional cases to prepare special compounds where the water is heavily charged with any unusual foreign element. The three special brands will, however, remove scale from almost any class of water, and leave no injurious effect on the boilers. Messrs. Wickens and Philip have long made a study of this subject, and anything that they would place on the market will be received with confidence by steam engineers of Canada, among whom they are so well known. The new company has issued a very neat booklet, which will be sent free from its offices in the Temple Building, Toronto.

Electric Flashes.

The Vankleek Hill Electric Company, Limited, has received an Ontario charter for incorporation.

The electrical pumping plant in the Perth, Ont., waterworks is reported to be giving complete satisfaction.

The Canadian General Electric Co. has sold to Alex. Dobson, of Beaverton, Ont., a standard 20-K.W. Edison dynamo.

The Rathbun Co., Deseronto, is building a freight motor for the Longue Pointe section of the Montreal Island Belt Line Railway.

Larkin & Sangster, contractors, Iroquois, Ont., have purchased from the Canadian General Electric Co., a 35-light arc dynamo with lamps.

The Canadian General Electric Co. has put in the last of the four 4,000-light single-phase alternators ordered by the Toronto Electric Light Co.

The Halifax Tramway Company has installed two 5,000-light monocyclic alternators from the works of the Canadian General Electric Company.

The Canadian General Electric Co. is furnishing to the Linde British Refrigerating Co., Montreal, two 50 h.p. and one 15 h.p. Induction motors.

The British American Corporation, Vancouver, B.C., has ordered a 100-light dynamo, with search lights and engine, from the Canadian General Electric Co.

The Canadian General Electric Co. has closed a contract with the corporation of Port Arthur for a railway car body equipped with G.E. 1,000 motors.

The Consolidated Electric Co., Victoria, B.C., is preparing to develop a large amount of power at Goldstream near the city. The plant will cost about $100,000.

The B. C. Bullion Extracting Co. has made a contract with the Canadian General Electric Co. to supply a 100 horse-power synchronising motor, and a 50 horse-power induction motor for their works, which are about a mile and a half from Rossland, B.C.

An Electrical Engineers' Association for the maritime provinces was formed in Halifax last month. James Waddle, Charlottetown, P.E.I., was one of the delegates present.

The London, Ont., Electrical Construction Company is said to be willing to establish itself in Kingston, Ont., if exemption from taxes, free site and free water are granted.

The Canadian Pacific Navigation Co., Victoria, B.C., has purchased from the Canadian General Electric Co., for one of their steamers, a multipolar direct connected set with marble switchboard.

Price Bros., Quebec, have ordered from the Canadian General Electric Co. a complete electric and steam plant for the Assiniboine Block, Winnipeg, Man. The generating plant will have capacity for 400 lamps.

Hamilton City Council has voted to buy from the Hamilton, Chedoke & Ancaster Electric Ry. the Becket mountain drive and quarry for $12,000. This makes the construction of the road almost a certainty.

D. Maxwell & Sons, St. Mary's, are installing an electric plant for lighting their factories, and have purchased for the purpose a 350-light Edison dynamo, manufactured by the Canadian General Electric Co.

The Manitoba Gas & Electric Light Co., of Winnipeg, has ordered from the Canadian General Electric Co., a 6,000-light direct-current generator to run at 150 revolutions a minute, also a 125-light brush arc machine.

The Canadian General Electric Co. has closed a contract with the Laurentide Pulp Co., at Grande Mere, Que., for two 55-kilowatt moderate speed direct current dynamos with marble panels and instruments complete.

As announced in another column, the chair of electrical engineering, in McGill University, is vacant by the retirement of Prof. Carus-Wilson. Applications for the position will be received by the secretary up to 20th June.

Letters patent have been issued to the Toronto Electric Motor Company, Limited, capital $50,000. Those incorporated are: J. C. McLachlan, H. S. Albertson, G. McLachlan, J. W. Thompson and W. A. Turbayne, Toronto.

The Toronto Railway Company is refitting its long Yonge St. cars with G.E. No. 800, four-motor equipments furnished by the Canadian General Electric Company. The old two-motor equipments did not furnish enough tractive force.

The Peoples Electric Co., of Windsor, Ont., is making extensions to the electric system and has placed an order with the Canadian General Electric Co. for all the material required, including over 1,000-light capacity in transformers.

The Windsor Hotel Company, Montreal, is making extensive alterations in the electric installation, and has ordered from the Canadian General Electric Co. two 1,000-light slow-speed multipolar generators with marble switchboard panels.

The Montreal Street Railway Company has determined to construct the Cote des Neiges line, and the management is waiting the return of James Ross from England to commence operations, which it is expected will be by May 15th.

The authorities of the Longue Pointe Asylum, Montreal, are building a branch street railway to connect the institution with the Montreal Belt Line, and the Canadian General Electric Co. is supplying a 110 K.W. steel-frame railway generator to furnish power.

The London Electric Co. is putting in a 6,000-light 300 K.W. alternator to extend the sphere of their lighting operations, and two 160 K.W. direct-current, direct-connected generators for power. These machines are being supplied by the Canadian General Electric Co.

The Ingersoll Packing Company has contracted with the Canadian General Electric Co., Limited, for a complete installation of incandescent lamps, arc lamps, motors and generator for their factories at Ingersoll, Ont. The generating apparatus will consist of a 25-kilowatt 125-volt multipolar dynamo of the C.G.E. Co.'s latest and most approved type.

The Cataract Power Co., Hamilton, is making progress with its power development at Decew Falls. The works are expected to be completed in eight or ten weeks.

The Ontario Rolling Mill Co., Hamilton, is rapidly rebuilding the works recently destroyed by fire ; they intend installing the most modern system of electric lighting throughout, and have placed an order with the Canadian General Electric Co., for one of their latest types of multipolar direct current dynamos having a capacity for 300 lights.

W. Doherty & Co., Clinton, Ont., have commenced work on their new factories, which they expect to have completed early in May. The new works are to be lighted throughout by electricity, and for this purpose they have closed a contract with the Canadian General Electric Co. for a 500-light dynamo, two 10 h.p. motors, and all wiring material required.

The Hon. John Haggart, W. A. Allan, A. Charlebois, Sir Sanford Fleming and R. G. Code, of Ottawa, are applying for incorporation as the Canadian Electric Water & Power Co., of Ottawa, capital $10,000, to establish waterworks and manufacturing electric machinery and electricity for the purposes of light, heat and power in the cities and towns of Canada.

J. R. Scott, an enterprising citizen of Napanee, has closed a contract with the Canadian General Electric Co. for a 100 K.W., 4,000-volt, three-phase generator of the revolving field type, for the purpose of supplying light and power to Napanee from a water power 8 miles distant. He will also supply light and power to intermediate points such as Napanee mills, Camden East, and Newburgh.

The Montreal Cotton Co., of Valleyfield, Que., has just placed an order with the Canadian General Electric Co. for two 600 h.p. three-phase generators, to be direct connected to turbines. This installation is a duplicate of the generators installed by the C.G.E. Co. over a year ago, and which have given entire satisfaction. With these four generators and station apparatus the company will have one of the most modern power stations on the continent.

The Electric Reduction Co., of Buckingham, Que., is putting in a 1,000 h.p. three-phase generator for electrolytic work. This machine is wound for a potential of 60 volts, and is of the revolving field and stationary armature type. It runs at 160 revolutions per minute, 75 volts, and is direct connected to a water-wheel. The equipment is of the same type as that furnished by the Canadian General Electric Co. to the West Kootenay Power & Light Co.

The Hamilton and Lake Erie Power Co. has been given by the government the power to increase its capital stock from one to three million dollars, and extension of time for three and six years respectively to begin and complete the work. Hon. W. R. Scott appeared for the promoters, and said the works were costing a very large sum and an extension of capital was needed. When completed there would be a great reduction in the cost of power in that district.

The Hon. J. Lanctot, M.D., of St. Henri; A. G. Bourbonniere, A. Christin St. Amour, Montreal; L. A. Sauve, St. Ignace du Coteau du Lac, and A. McNown, Cornwall, have applied for incorporation under the name of "La Compagnie d'Electricite de Soulanges." The object of the proposed company is to operate telegraph and telephone lines in the county of Soulanges, with a capital stock of ten thousand dollars. The principal place of business will be at Coteau Landing.

The Manitoba Gas & Electric Co., Winnipeg, is making very extensive alterations and additions to its plant, and have placed an order with the Canadian General Electric Co. for a 300-kilowatt alternating generator of their monocylic design, and one 125-light brush arc dynamo to be direct connected to vertical engine. The Canadian General Electric Co. is thoroughly overhauling the outside construction work, and equipping the system with their standard type H. transformers throughout.

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L. A. Campbell, for several years chief engineer of the Canadian General Electric Company, has been appointed general manager and electrical engineer of the West Kootenay Power and Light Company. Under the superintendence of Mr. Campbell, this company has already installed 2,000 horse power for delivery to Rossland, B.C., and has a waterway developed for 7,000 horse power altogether. The company supplies power to the celebrated War Eagle mine, whose plant is referred to elsewhere in this issue.

At a meeting of the Royal Electric Engineering Society, held a short time ago, K. B. Thornton, of the Royal Electric Co., read a paper on Alternating Current Arc Lamps; also at a meeting of the society, held March 31st, W. F. McLaren and R. F. Morkill, of the Royal Electric Works, read a paper on Alternating Current Motors. Mr. Dix, of the same Company, will read a paper at the next meeting, April 14th. The society are holding their meetings in the Board Room at the Royal Electric Co.'s General Offices, which has been very kindly loaned by Mr. W. H. Browne.

It will be remembered that in the action taken by the Montreal Street Railway Company against the Montreal Park & Island Railway Company, on account of loss from the fire at the exhibition ground buildings, when a number of cars leased by the Street Railway Company to the Park & Island Company were destroyed, the Superior Court granted the Street Railway Company $5,786 damages. From that judgment there were two appeals, one from the Street Railway Company itself, claiming that the amount granted was too small, and another from the Park & Island Company, asking that the action be dismissed. The Court of Appeal held that there had been no fault or negligence on the part of the Park & Island Railway Company or its employees and the damage to the cars had been caused by an irresistible cause. Under those circumstances the judgment of the court below must be reversed, and the action of the Street Railway Company must be dismissed.

The Toronto Electric Motor Company's business has again out-grown its premises, though two or three extensions have been made since it was established in Adelaide St. The Company is now building a factory of its own in Pearl St., and expects to move into its new premises in the course of a month. Among the orders awaiting delivery on the books are 100 arc lamps, for the Citizens' Light and Power Co., Montreal; a 5 horse power motor for T. H. Dryden, Toronto, and one of similar size for R. Anderson, Ottawa; two 30 horse power motors for the Mail and Empire, a 30 k.w. generator for the elevator at Coteau Landing (owned by John S. Metcalfe & Co., Chicago), a 60 k.w. generator for R. E. T. Pringle, Montreal, and a 130 k.w. generator, and a 140 horse power motor for the T. Eaton Company, Toronto, the last-named being the sixteenth machine furnished by this firm to the great departmental store. Another interesting installation is a 200-light dynamo and a 20 k.w. power generator for the Rat Portage Lumber Company, to be used for lighting the mills and for operating an electric locomotive for a tramway running throughout the Company's yard.

Mining Matters.

The Dominion Coal Co. is building a large number of cars.

Oil is reported in the township of Brooke, near Alvinston, Ont.

The Canadian Mining Institute has applied for a Dominion charter of incorporation.

Another oil well at Point Edward, Ont., is completed, and its pumping qualities tested with satisfactory results.

The Hamilton Board of Trade has asked the Dominion Government to impose an export duty on nickel ore.

The British Columbia Smelting & Refining Co. has transferred the smelter at Trail, B.C., to the C.P.R. Company.

The Iron Mask Mine, Rossland, B.C., is putting in one of the Jenckes Machine Co.'s smaller size hoisting engines.

The discovery of an extensive deposit of valuable iron ore is reported to be made in the Laurentides, about eighty miles from Montreal, on property owned by Adolph Trempe, brother of the Montreal detective of that name.

British Columbia business still continues brisk. The Jenckes Machine Co. reports the demand for mining machinery quite active.

The Rossland branch of the Jenckes Machine Co. recently placed a No. 5 Cameron pump with the Center Star Mine, also a No. 6 with the Monte Cristo.

The Dominion Government has authorized the issue of free miners' licenses at the summits of the Chilcoot and White passes, at the head of Lynn Canal.

The receipts from the corporation natural gas plant last year in Leamington, Ont., were $10,406.14, and the expenses in connection with the plant were $770.

Large coal beds are said to have been located on or near the line of the proposed Glenora and Teslin Lake Railway, about fifty miles from Telegraph Creek.

The Boundary Creek District, of British Columbia, is coming forward, and it is very likely that a number of large development plants will be put in during the coming season.

E. E. Pettigrew, of Winnipeg, has placed an order with the Jenckes Machine Co., Sherbrooke, for a five-stamp mill complete, with thirty-five horse power engine and portable boiler.

The property of the Non-Magnetic Asbestos Co., of Point au Chene, Que., is advertised for sale in another column; the sale to take place on the 15th. The property is reported to be a very valuable one.

The Canadian Rand Drill Company has sold to R. O. Jennings, Fort Steele, B.C., a big power pump for use in the hydraulic mining plant which the Jennings Company is installing on Brewery Creek.

Texada Islands, off Jervis Inlet, B.C., will, it is said, soon have a smelter. The plant was ordered by the Van Anda Company, which has brought ten cold-copper properties on Texada to an advanced stage of development.

The Kenneth Mining and Development Co., at Rossland, B.C., is making an addition to its equipment in the shape of a 7 x 10 double-cylinder hoisting engine, with boiler and all appliances complete, furnished by the Jenckes Machine Co.

Vivian & Sons, Swansea, Wales, and the Elbois Metal Company, of Burryport, South Wales, have, it is said, as the result of the success of trials, decided to come into the British Columbia market for the purpose of smelting all kinds of ore and furnace products.

John Fenton, farmer, who lives near Ryckman's Corners, Ont., has had natural gas on his farm for several years, sufficient to heat and light the house, and recently a big flow of gas was struck at a depth of 200 feet. The previous flow was from a well 460 feet deep.

The Brookfield Mining Co., North Brookfield, N.S., has bought a hoisting engine and other machinery from Austen Bros., for use on the Dunbrack property, recently purchased by them. They propose to sink a shaft about 200 feet and then drive levels to thoroughly test the belt.

Development still continues on the Golden Cache Mine, Rossland, B.C. The company claim to have a narrow claim streak, running $200, with the rest of the ledge containing average values to pay $1 net. Contracts, amounting to $40,000, have been let for electric and hydraulic plants.

The Electric Reduction Co., of Buckingham, Que., is proceeding to develop the water-power, and as a first step has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a pair of 45" crocker turbines, to be installed complete with wheel cases, draft-tubes, governor, etc.

The emery found on the East shore of Lake Winnipeg has been pronounced by experts to be of the very finest quality. The deposits are known to extend over an area of twenty-five square miles. About 50 claims have been taken up. Deposits of aluminum and quicksilver have also, it is said, been found.

The proposed British Columbia Chamber of Mines has been established. The initial meeting was held at Vancouver, B.C., with Dr. Selwyn, F.R.S., in the chair, and representatives of mining interests from different districts present. Twenty-five signed as representative and five as associate members. The following were elected an executive committee: W. A. Carlyle, W. Pellew Harvey, W. White, H. Abbott, H. Cohen, Barclay Bonthrone, A. St. G. Hamersley, F. S. Taggart, C. C. Bennett, Dr. Selwyn and Dr. Bell-Irving.

The B. C. Goldfields Co., of Toronto, has recently placed an extensive order with the Jenckes Machine Co., for a ten-stamp battery complete with two vanners, two ore feeders, grizzly, Blake-Marsden crusher, and all the various apparatus making up a complete modern milling plant. The outfit is to be delivered at Nelson, B.C.

The British Columbia Copper Co., Anaconda, B.C., have just contracted with the James Cooper Mfg. Co., Limited, Montreal, for the installation of an Ingersoll-Sergeant ten-drill compressor plant, complete with ten drills, battery of boilers, Lidgerwood hoisting engines, pumps, heaters, and all necessary equipment to make the plant complete.

Dr. J. B. Porter, Professor of Mineralogy at McGill, is now in the mining regions of Nova Scotia, at the head of a large field prospector's class from McGill University. They will examine portions of Cape Breton, and the Guysborough gold fields, remaining in the east about six weeks. The class was sent out through the generosity of W. C. McDonald.

Dr. Gilpin, inspector of Nova Scotia mines, has sent to the Provincial Government a report on the result of his recent official trip to Whycocomagh Cape Breton. He says the gold discoveries are very valuable but does not go into minute details. Dr. Gilpin found very rich quartz and also free gold in sand taken from the bed of the Whycocomagh River.

The annual report of the B. C. Dept. of Mines has been presented to the Legislature. It shows that the total output of minerals, including coal, in 1897, was valued at $10,455,268, an increase of 40 per cent. over the previous year's yield. The gold value was $2,646,000; silver, $3,272,000; lead, $1,390,000.17; coal, $2,648,562. West Kootenay produced to the value of $6,765,000.

An oil well has been struck on the farm of Benjamin Boothroyd, about a mile from Thamesville, Ont. F. Carmen is the proprietor of the well. One night there were two hundred barrels pumped in twelve hours, and the average yield is still almost equal to that. There is another well on the adjoining farm, the property of John Herbert, which promises to be almost equal.

An Edmonton despatch says that letters to Rev. Father Husson and R. Hardisty confirm the report that "Cayuse" Graham has come across the mountains from the head waters of the Pelly River, and has struck pay dirt at ten to twenty dollars a day. Graham crossed the Upper Liard, west of the mountains, in November, and reached Fort St. John on February 1st, with horses and sleds.

A letter recently received by Bishop Pascal, of Prince Albert, from Rev. Father Ancel, stationed at Hay River Mission, in the North-West Territories, states that a party of prospectors have found rich gold deposits on both Hay and Buffalo rivers, emptying into Great Slave Lake. These rivers are located about 700 miles north of Prince Albert on the Regina and Prince Albert route to the Klondyke.

F. C. Flannery, secretary-treasurer of the Toronto Smelting Company, proposes erecting at Madoc, Ont., a plant to treat the mispickel ores of Hastings County; he recently showed samples of the arsenic produced at the company's small test-mill at Millbridge, Ont. The company has now a ten ton water jacket smelter, which is to be put up at Madoc, and started as soon as possible. The company will treat the mispickel ores for arsenic with gold and mineral wool as bi-products.

Free mining machinery to the value of $128,780 was admitted into Canada during the fiscal year ended 30th June last, having been supplied by the following countries: Great Britain, $9,266; Denmark, $2,451; Germany, $2,864, and the United States, $114,239. Of this amount Ontario got $30,308; Quebec, $24,812; Nova Scotia, $21,520; New Brunswick, $452; Manitoba, $695; British Columbia, $44,087, and the Northwest Territories, $5,897. In addition to these should be mentioned diamond drills purchased in the United States of a value of $19,880. Among the dutiable articles we find 184 steam pumps, valued for duty at $24,860.

MOVING TIME! Subscribers are reminded to notify us of any change in address necessary Give both old and new addresses.

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Marine News.

The contract for repairs to the steamer Rosedale was awarded the Caledonia Iron Works, Montreal. The repairs will amount to about $28,000.

The Geological Survey of the United States has ordered a large number of canoes from the Peterboro Canoe Company for the use of exploring parties in Alaska.

The propeller Persia has been bought by W. A. Geddes, Toronto, and Jacques, Montreal, Capt. Crangle and J. H. G. Hagarty having sold to those gentlemen their interest.

Clinton B. Sears is considering the matter of raising the bones of the old steamer Winnipeg, of the Collingwood line, which lie in shallow water at the bottom of Duluth harbor.

The Canadian General Electric Co is equipping, with incandescent light, a steamer being built by the British Columbia Iron Works, for the Klondyke Exploration Co., Limited.

The Canadian Pacific Navigation Co. has purchased from the Canadian General Electric Co., a 125-light, incandescent plant for a steamer running from Vancouver to the Stikine River.

The British Columbia Iron Works Co. has ordered a 6-kilowatt incandescent dynamo from the Canadian General Electric Co., for a steamer which it is building for the Klondyke trade.

The Canadian Development Co., Victoria, B.C., of which H. Maitland Kersey is Managing Director, has ordered three incandescent light equipments, for new steamers, from the Canadian General Electric Co.

The Hudson Bay Company has placed a contract with the Canadian General Electric Co. for two 100-light incandescent equipments, to go on their new steamers, running from Vancouver and Victoria to the Stikine River.

Messrs. Cameron, Collingwood and Burton, of Barrie, have arranged to place the City of Collingwood and the Majestic on the route between Collingwood, Owen Sound, Sault Ste. Marie, Port Arthur, Fort William and Duluth.

The Allan Line has given a contract for the construction of a ten thousand ton steamer, to be known as the "Sicilian" and a sister ship to be the "Tunisian." The length is five hundred feet, beam 60 feet, speed sixteen knots, capacity 1,050 passengers.

The directors of the Richelieu and Ontario Navigation Company have appointed a new official, to be known as inspector of stewards. H. Bonchard, who has been in the employment of the company for 17 years, has received the appointment, with headquarters at Montreal.

J. A. Mara, late member of parliament for Yale and Kootenay, is building a river steamer at Vancouver for the Yukon traffic. She is said to be the largest boat that will be employed on the rivers up North, being 520 feet long, 32 feet beam, 5½ feet depth of hold, and will cost in the neighborhood of $25,000.

The Canadian General Electric Co. has a contract for supplying three direct-connected units for the C.P.R. steamers which are to go on the Stikine route. These units will consist of a 4-kilowatt, 70-light incandescent dynamo, direct-connected to a vertical high-speed engine, running at 606 revolutions per minute.

W. Bell Dawson, engineer in charge of Tidal Survey, has this year issued, in neat pamphlet form, Tide Tables for Charlottetown, Pictou and St. Paul Island, C.B., for 1898, with Tidal Differences for Northumberland Strait, and for the open Gulf shore, from Miramichi along the north coast of Prince Edward Island.

The Canadian General Electric Co. is installing a Direct Connected Lighting unit on board the C.P.R. steamship Athabasca, consisting of a 500-light incandescent dynamo, direct connected to a 50 h.p. high speed "Ideal" engine. This unit, which is very compact, occupies a floor space of less than 6 ft. x 9 ft. The dynamo is of the latest steel frame multipolar type, with ventilated armature. A marble switchboard, on which are mounted a standard equipment of instruments, is also part of the new equipment, which when finished will be the most complete on any of the steamers now running on the upper lakes.

Capt. Crawford will again this year be Commodore of the Hamilton Steamboat Company's fleet. He will sail the Macassa in the spring and fall and the Modjeska during the busy season. Capt. Maddicks will be in command of the Macassa while Capt. Crawford is on the Modjeska.

The total number of casualties to British and Canadian sea-going vessels in Canadian waters, and to Canadian sea-going vessels in waters other than those of Canada during the year, as stated in the report to Parliament, of the Dept. of Marine, was two hundred and thirteen, representing a tonnage of 80,317 tons register, and the amount of loss, both partial and total, to vessels and cargoes, as far as ascertained, was $718,293. The number of casualties to inland vessels was twenty-seven, tonnage, 5,726; loss, $48,350. The number of lives reported lost in connection with these casualties was thirty-four.

The following candidates, recently examined by W. L. Waring, St. John, N.B., have passed and will be granted marine certificates: Geo. H. Waring, jr., of St. John, second engineer of Prince Rupert, chief engineer's certificate, valid in Great Britain; Fred. John Lewis, of St. John, second-class certificate, valid in Great Britain; Charles Helman Hanson, of Chatham, third-class certificate; Geo. Frederick McRoberts, of St. Andrews, fourth-class certificate; George Herbert Burpee, Sheffield, Sunbury County, fourth-class certificate.

The Manhattan Steamship Company was incorporated Jan., 1898, with a capital of $1,000,000, with the following directors: J. J. Hillman, Philadelphia, president; Jos. D. Huggins, New York, vice-president; N. L. Newcomb, New York, general mgr.; H. E. Alexander, Wm. F. Weiss, Thos. W. Buck, Roland F. Hill, Tunis G. Bergen, New York; Isaac C. Ogden, Orange, N.J.; Beverley S. Reed, Boston; C. Everett Evans, Taunton, Mass. The offices of the company are at 11 Broadway, New York. Contracts have been given for the construction of three steel twin screw passenger and freight steamers. The dimensions of these steamers are 250 feet long by 45 feet beam. Each of these steamers contains two engines, 22 x 36 x 55 x 28 inch stroke; six boilers, 11 feet 6 inches in diameter by 12 feet 6 inches long, giving a sea speed of 17 knots per hour. These steamers are of the most modern construction, with large space devoted to cold storage. The company will operate a steamship service between New York, Maine and the maritime provinces. Pier No. 1, North River, New York, has been leased at a rental of $35,000 a year for a period of ten years.

Considerable discussion is going on in marine circles in St. John, N.B., on the subject of marine engineers' permits. The regularly qualified engineers are not satisfied with the present system of granting such permits, and claim that there are many inconsistencies in the laws with regard to granting papers to men to make them marine engineers and in the rulings of the men who are in power to grant the papers. The engineers who study the laws, say that a fourth class engineer, who is compelled to have certain machine-shop experience, and also experience in the engineering of a steamboat, is not permitted to take charge of the machinery of any passenger boat, and the man who holds the permit has not to have all these qualifications and can run any passenger boat of nine-horse power. The act provides that a temporary certificate may be granted and be in force for a term not exceeding one year to an applicant "sufficiently qualified by his knowledge of steamboat machinery, and his experience as engineer on a steamboat, authorizing him to act as an engineer of a steamboat carrying passengers, having an engine of not more than four nominal horse power if the engine is a single cylinder engine, or nine nominal horse power if the engine is of the compound type.

Everything in the marine line is rushing at Gravenhurst, Ont., "We had the launch of a new steamer built last winter for Homer & Co., of this town," writes a correspondent. "She is 65 feet long, 14 feet beam, 6 foot hold. She is built all of oak timber, and calculates for a passenger steamer will carry 130 passengers. Her speed is 12 miles an hour. She was built by Davis & Sons, Kingston. The same firm have a contract to enlarge the steamer "Kenozha," for the Muskoka Nav. Co. They are adding 18 feet to her length, making her 126 feet long. There will be new cabins, 56 feet long, built on the promenade deck, besides new pilot house, and captain rooms on the hurricane deck. Her rebuilding will cost $3,000, and is to be ready for work by June first."

Railway Matters.

The Quebec Central Railway is making extensive additions and improvements at the car shops in Newington. A new engine house, with a capacity of ten engines, has been erected.

The Grand Trunk will lay 120 miles of new track this summer between Niagara Falls, Sarnia and Windsor. The new rails will weigh 80 pounds to the yard; that which is down at present weighs from 56 to 66 pounds.

The managers of the Ottawa & Parry Sound R. R. have purchased sixteen new mogul engines in anticipation of a great increase in the grain business. They are ten-wheelers, and weigh 156,000 pounds each, without the tender or water in the boilers.

The Grand Trunk Railway Company will move the head offices of two branches of the construction work to Toronto. General Roadmaster Ferguson will be established here with his staff, and offices are also being prepared for the superintendent of bridges.

Both the G.T.R. and C.P.R. are introducing a new code of lamp signals to use on their freight trains. In addition to the usual tail lamps there will be an extra large one placed on the top of the conductor's van, and will be known as the copula lamp. This lamp will be an extra safe-guard against rear accidents. The engineer will also be in better communication with the end of the train.

Sir William Van Horne, at the annual meeting of the C.P.R. shareholders, remarked, in connection with the double-tracking of the Montreal-Toronto line, that it is ultimately intended to double track from Port Arthur to Winnipeg, and from Montreal to Farnham, and steps had already been taken in that direction, but the Montreal-Toronto section was regarded as the most urgent.

The following new appointments on the Canada Atlantic Railway went into effect recently. Mr. C. J. Smith is now general traffic manager; Mr. J. E. Walsh has been appointed assistant general passenger agent; Mr. W. P. Hinton has been appointed assistant general freight agent. These officers will have their headquarters at Ottawa, where the general offices of this company are located. Mr. M. A. Overend has been appointed foreign freight agent, with headquarters at 115 Board of Trade Building, Montreal.

Premier Greenway's Manitoba Ry. scheme includes 80 miles south-east from Winnipeg towards Lake of the Woods, upon which a guarantee of $8,000 per mile is given, controls rates secured as on the Dauphin railway, also large reductions on cordwood and sawlogs, which, it is believed, will bring the mill to Winnipeg. Next year arrangements will be made to connect the line with the Rainy River railway, and thus secure the road to Lake Superior, with a ten-cent rate scheme; also includes extending the Dauphin railway 140 miles north to the Saskatchewan River, through the fertile Swan River valley; also on a guarantee of $8,000 per mile, the government being secured by a first mortgage on the road. This will be half way to Hudson's Bay.

In the case of P. Hannaford v. the G.T.R., the plaintiff claims a year's salary ($6,000), in lieu of notice, and claims that his discharge was without cause and illegal, putting in evidence a letter from Sir Charles Rivers-Wilson, in which it was stated that nothing but absolute necessity caused the directors to dispense with Mr. Hannaford's "valuable" services. The company, on the contrary, claim that Mr. Hannaford had used his position for purposes other than the interests of the company; that he had employed servants of the company to do work for himself; that he had promoted his son without getting the approval of the general manager of the company to the promotion, and that, in any case, he knew of and approved an agreement signed by the employes of the road to accept a month's warning at any time. Strong evidence was given by several employees that they had done work for Mr. Hannaford on his private residence, both in time and with materials paid for by the company.

Word has been received at Kincardine, Ont., of the death of L. B. Hamlin, C.E., formerly, it is said, resident of that town. Mr. Hamlin was county engineer of Bruce for some years. He was engaged on the Government service in the Yukon country, and was frozen to death in the Klondyke.

Personal.

W. J. Harkom, Montreal, is appointed assistant to the mechanical superintendent of the C.P.R.

The death of Captain Campbell occurred on the S.S. "Lake Ontario" on Saturday, April 2.

Geo. Booth, Toronto, was elected treasurer of the Canadian Manufacturers' Association at the recent annual meeting.

D. J. Macdonald, B.C. Provincial Mine Inspector, resigned his position on April 10. He has taken a position with a mining company and will reside in Rossland.

James Warren, C.E., Walkerton, Ont., has been appointed town engineer for Waterloo, Ont. The town is without a map, and the first thing Mr. Warren will have to do is to make one.

The Chatham city council has appointed Charles Topp, C.E., of Bracebridge, city engineer. The salary will be $1,000, and the present waterworks engineer's services will be dispensed with, it is said

At London, Ont., April 11th, Miss Mary Rolston was married to Samuel Break, general manager of the London Electrical Construction Company, and formerly superintendent of the London Street Railway.

J. A. Sheedy, of the Illinois Bridge Works, Chicago, Ill., has been appointed master of bridges and buildings on the Grand Trunk Railway system, in place of Will am Crawford, of London, Ont., resigned.

T. E. McLelan, manager of the Berlin and Waterloo Street Railway, has resigned his position to go to the Klondyke. He will be succeeded by Hedley H. Hilborn, of Montreal, who has been in the service of the Montreal Street Railway.

H. B. Spencer has been appointed superintendent of the Eastern division of the C.P.R. and the Montreal-Ottawa line, with headquarters at Ottawa. J. E. A. Robillard, the former superintendent, will have charge of the Labelle and St. Jerome branch of the C.P.R.

P. A. Dickson, aged 40, died at Brantford, April 24th. He was for a number of years electrician for the Brantford Electric Power Company, leaving there last summer for British Columbia, where he contracted a severe cold, which resulted in his death.

Mons. Ephrem Valiquet, who has just been elected president of L'Association De Secours Mutuels des Ingenieurs Mecaniciens, was presented by W. Rutherford & Sons with a handsome silver jug as a token of respect on the occasion of his leaving their employ to become foreman for Lymburner & Mathews, of Montreal.

William Wilson, engineer of the S.S. "Alert," died suddenly a short time ago, he having, up to the hour of his death, been in perfect health. He was a native of Glasgow, Scotland, and came to St. John's, Nfld., 37 years ago, as engineer to Baine Johnstone & Co ; since then he has been with Bowring Bros., in the Tug Co., and for the past 11 years an employee of Job Bros.

Prof. Hugh L. Callendar, F.R.S., of McGill University, has been appointed to the Quain professorship of physics at University College, London, vacated by the resignation of Professor Carey-Foster. The friends of Professor Callendar cannot but be pleased at his appointment to what is considered a leading professorship in England, but there is not so much rejoicing at McGill, where his talents will be greatly missed. When accepting Prof. Callendar's resignation the McGill Faculties of Arts and Applied Science unanimously passed a resolution of regret in which they expressed their appreciation of his great merit and ability.

John Watson, the well-known stationary engineer, died recently at his home in Montreal. Mr. Watson was born in Edinburgh, Scotland, seventy-eight years ago, and came to Montreal when about twenty-six years of age. He was for a number of years employed by the Grand Trunk Railway, and had the distinction of making one of the party that accompanied the first engine run over the line to Lachine. Afterwards he went into business for himself as a machinist on Chenneville street, and later was in partnership with his brother, the late Thomas Watson. When the new post-office was built he accepted the position of engineer there, where he was up till about four years ago.

The harbor master of Montreal, Captain Thos. Howard, who died recently at his home in that city, was born at Shinroan, Queen's County, Ireland, on September 15, 1826, and came to Canada in 1842. For a time after his arrival he was in the employ of the late Hon. John Hamilton, and later on entered the service of the Richelieu & Ontario Navigation Company. For some years he commanded the "Banshee," "St. Lawrence," and other vessels of the company plying between Montreal and Western ports, and was subsequently appointed manager of the Ontario division of the company. In March, 1881, he was appointed harbor master at Montreal, a position which he held until the day of his death.

Prof. C. A. Carus-Wilson has announced his intention of resigning the chair of Electrical Engineering at McGill University on September 1. He came to Montreal in 1890, having been previously on the staff of the Royal College of Engineering, Cooper's Hill, England. His resignation will be a great loss to McGill College. His future permanent address will be "Hanover Lodge, Kensington Park, London W., England." During May, Prof. Carus-Wilson will give the Cantor lectures on electric locomotives at the Society of Arts, London, and throughout the summer he proposes to devote special attention to electric railways, a subject of great and increasing importance in England now. The volume on electro-dynamics which he has written for Messrs. Longmans, Green & Co. (London and New York), will be published at once.

Chauncey M. Depew retired from the presidency of the New York Central on April 20th and was succeeded by S. R. Callaway. Mr. Callaway is a Canadian, entering the office of Mr. Hickson at Montreal in 1863, when 13 years of age. In 1865 he went as secretary to Gilman Cheney, manager of the Canadian Express Company, and left there in 1869 to enter the service of the Great Western Railway under W. Wallace, the superintendent at London, and subsequently private secretary to W. K. Muir at Hamilton. Mr. Callaway retired from the Great Western to enter the service of the Detroit and Milwaukee, of which road he was superintendent from 1875 to 1878. Upon the absorption of the D. & M. Railway by the Great Western Mr. Callaway was appointed general superintendent of the Detroit and Bay City Railway, and in 1880 general manager of the Chicago and Grand Trunk and president of the Western Indiana railways. In 1884 Mr. Callaway accepted the position of vice-president and general manager of the Union Pacific Railway and the allied lines of nearly 6,000 miles. In 1887 he was elected president of the Toledo, St. Louis and Kansas City Railway, and since then he left that road to accept the presidency of the Lake Shore and Michigan Southern Railway.

FIRES OF THE MONTH.

April 1st.—The Sine Creamery, Sine P.O., Ont., destroyed.——April 2nd.—Geo. H. Hees, Sons & Co., window shade factory, Davenport Road, Toronto. Loss, $40,000, being rebuilt.——April 8th.—G. W. Green's wood-working factory, Ashburnham, Ont. Loss, $8,000 ; insurance, $4,500.——April 8th.—Lebel & Wilson's Lead Works, London, Ont. Loss, $4,000.——April 11th.—Chadwick Bros., Hamilton, metal spinning shop. Damages about $200.——April 13th.—F. Routhier & Sons, foundry, Vankleek Hill, Ont. Loss, $3,000 ; insurance, $1,000.——April 13th.—Small saw mill, Newbury Junction, N.B. (Jas. Carr, Woodstock, N B., proprietor). Loss, $2,000.——April 19th.—Doan's tannery, Clinton, fire starting in the boiler room. Total loss.——April 19th.—Ore house at the Payne mine, Nelson, B.C. Loss, $10,000.——April 19th.—Gaw's planing mill, Place D'Armes, Kingston, Ont. Loss, $12,000 ; insurance, $5,000.——April 23rd.—The cupola of Wortman & Ward's foundry, London, Ont. Damages, $500. ——April 30th.—The Rathbun Co.'s terra cotta works, at Deseronto, Ont., plant destroyed. Loss about $100,000 ; partially iusured.——May 1st.—Jas. McLatchie's machine shop, Cardinal, Ont Loss about $5,000.

IMPULSE WATER WHEELS.*

By J. T. Farmer, Ma.E.

The development of power by means of impulse water wheels, has been receiving considerable attention during the past ten years. Water power is to be met with under varying conditions and in various surroundings; and the means best adapted for the utilization of the power vary with those conditions and surroundings.

Among the means devised by man at different times before the advent of the impulse wheel for utilizing the water power that was going to waste around him, one has easily taken the foremost place, and, indeed, has, by a process of the survival of the fittest, practically ousted all other methods from a position of being worthy of serious consideration. The turbine has at the present day almost entirely taken the place of the earlier devices in use, which have either been consigned to museums as curiosities or are regarded as picturesque additions to the landscape.

The impulse water wheel probably differs as much from the various forms of turbine in construction and in action as the turbine does from an overshot or breast water wheel. The previous statement with regard to the turbine must therefore be further modified so far as it is found that the impulse motor is finding favor with those who utilize water power.

*From a Paper read before the Canadian Society of Civil Engineers.

It has been said that "countless wealth is being squandered in all the torrents and water courses of the world." But it might be added that unless the proper means are taken for its utilization, wealth of energy avails little more to man than that of the tides of Jupiter.

It seems at first sight a very simple matter to place a wheel in position to take up the energy of water; but in practice that arrangement is generally found to involve more or less costly construction in the way of dams, basins, canals, flumes and even tunnels. This is particularly the case where the use of turbines is contemplated, and this consideration is frequently sufficient to annihilate the expediency of thus attempting to utilize a known and otherwise available source of power.

These adverse conditions are forcibly illustrated in the mountainous districts of the North American Continent. Water power is there in abundance, but it is that of mountain torrents: as a rule inconsiderable in volume of water, but, on account of the configuration of the country, affording large heads. The latter circumstance makes any constructive work very costly, and in most instances would put the use of an ordinary turbine out of the question.

It was from such causes that the Western States became the birthplace of that system of water power of which the essential feature is an impulse water wheel. The simplification made possible in this system is that of the substitution of a pipe and nozzle of insignificant dimensions for the massive head race and wheel pit associated with the use of a turbine.

The first impulse wheels brought into use were of the very crudest description; with the increasing use of the system, however, came the development which attends every invention which has a large field of usefulness open to it. The impulse wheel of the present day ranks as fairly efficient among the various means of utilizing natural energy.

At this stage it becomes a question to what extent it may be desirable to employ the impulse wheel outside the conditions under which it first sprang into existence. This problem is specially interesting in a country where there is an abundance of water power, and at a time when the utilization of water power is assuming the place of one of the most important engineering questions of the day. The object of this paper is to record the results of some experimental research on this subject, and also to discuss the question by the light of those results and from other considerations.

The history of the development of the impulse water wheel may advantageously be sketched briefly. The first wheels of this class were simply provided with flat projections on the rim of the wheel, and the jet was arranged to impinge normally on these flat surfaces. This was what was known as the hurdy-gurdy. It can easily be shown from theoretical considerations that the ideal efficiency of such a wheel is 50 per cent., but it is probable that most of those in use did not give a greater efficiency than from 20 to 30 per cent.

The first notable improvement was that of substituting hollow cups for the flat vanes, so that the jet struck the interior part of the cup and was deflected back again until it left the vane, traveling, with respect to the vane, in almost the opposite direction to that in which it was traveling before impact. This formation at once largely increased the efficiency, but in practice the efficiency was still far from what it theoretically might be.

The next modification was that of so curving the surface of the cup that the jet might follow the surface with very little deviation at the first point of contact. Thus some wheels are formed with a conical projection in the interior of the cup at the point where the jet strikes the surface, so that the water on striking may begin to pass along the generating lines of the cove, and may gradually be deflected further to follow the curved sides of the interior of the vane. The more common construction is to place a wedge-shaped projection across the interior of the cup or vane. This modification was introduced about 1880. The function of the wedge is two-fold.

(1) To prevent the heaping of dead water upon the vane during its passage through the arc of action, or the part of its path in which the vane receives the jet of water. (2) To give the diverted streams a direction of motion which will finally carry them clear of the wheel.

In a bucket unprovided with any conical or wedge-shaped projection, there is no sudden angular deflection of the water. Some of the water is heaped upon the flat surface upon which the jet is impinging, thereby forming a curved surface over which the following water is deflected. With a stationary vane on which the stream is continuously playing, the loss of force due to this cause is very slight. When, however, the impact is taking place intermittently on a moving vane, the dead water is discharged after very inefficient action at the end of every short period of action, and the total loss in effective work may be considerable. This loss is reduced by placing a solid projection in the bucket, which takes the place of that formed by the water and leaves all the water free to be deflected in the most efficient manner. As regards the second function of the wedge, it is well known that when a stream of water strikes normally upon a surface, it is deflected equally in all directions. This is illustrated in the wheel bucket. The same action takes place when the stream strikes centrally upon the apex of a cone. This is undesirable in the case of the vane of a water wheel, as the water which is deflected towards the centre of the wheel gets into position to strike the back of the following vane, thus opposing the useful effect of the action. Then the jet strikes a wedge, it is cut into two portions, which are deflected away from one another in a plane perpendicular to the cutting edge of the wedge. In a wheel this motion causes the water to be discharged at each side of the wheel where it is free from all liability to interfere with any following parts of the wheel.

Numerous modifications of the form of the curved surfaces of the buckets have been brought out at different times by inventors with a view of modifying the passage of the water over the vane in some particular, but it is not necessary to describe them more particularly.

Of the impulse wheels in use at the present day the best known is probably the Pelton water wheel. These wheels are made in sizes varying from 6 in. to 6 ft. in diameter, according to the head of water available, and the velocity required. These wheels have been applied under heads ranging up to 1,700 feet, and, as has been said, there is no doubt that under such conditions the highest efficiency is realized. On the other hand, there are said to be instances in which Pelton wheels are running with good results under heads of from 50 to 75 feet.

The writer recently made a series of tests on a small wheel of this class, catalogued as the Pelton Motor No. 3. This wheel is approximately 18 in. in diameter, and the weight of the whole machine is given as 320 pounds.

The tests were made in the hydraulic laboratory of McGill University, and a brief description of the methods employed will be given. It was impossible to make tests with heads as high as some of those under which these motors run. The maximum head employed was that afforded by the city supply from the high-level reservoir, which gives a pressure of 125 lbs. per square in. in the laboratory, equivalent to a head of 290 feet. Lower pressures were also obtained by throttling the supply from the same source. These trials will give an idea of what may be expected of this type of motor when used under ordinary heads of from 100 to 300 feet. In many districts these are as large heads as are commonly met with. Also, where it is proposed to take power from a water-works system, the pressure under which water is supplied would rarely exceed 125 lbs. per square inch. In the present series of trials the wheel tested was small compared with many in use: the effective work done did not in any case exceed 7 horse-power. There is no doubt that with a machine designed on a larger scale, as with larger heads, the efficiency would show some increase over the values found in the present case. The results obtained in these experiments are offered as bearing directly on the question of the utilization of this system for small amounts of power under the conditions usually met with in districts outside those referred to as abounding in very high falls of water. With reason and judgment, the general conclusions arrived at by the consideration of these results may be extended to cases where the machinery and the generation of power is on a larger scale.

For the purposes of trial the wheel was set up as received from the makers, and the auxiliary apparatus was fitted in accordance with their instructions. The water, after passing through the valve which was used to regulate the pressure, was led along a length of 2½-inch pipe straight for 8 or 10 feet before reaching the nozzle. A Bourdon gauge was fitted on the supply-pipe less than one foot from the mouth of the nozzle-tip. This gauge was arranged on a pressure-chamber, enveloping the pipe and communicating with the interior through a series of small holes. Before being used the gauge was calibrated by means of a gauge tester. In the experiments the

pressure in the pipe of course varied slightly. The pressure was read at intervals of one or two minutes, and the mean value during the whole trial was accepted as the pressure under which the flow took place. The extreme variation of the pressure was about one pound per square inch.

Three different sized nozzle tips were supplied with the wheel. These nozzles tapered gradually on the inside from the diameter of the supply pipe to that of the actual orifice. The outlet diameters were : .5277 in., .6307 in., .7532 in. Sets of trials were made, using the largest and smallest of these nozzle tips, the largest giving the more satisfactory results. The water was discharged from the motor into a flume beneath, whence it ran into measuring tanks, and all the water used was thus actually measured. For the purposes of these trials two tanks were used, each of the capacity of 1,000 gallons; these had both been previously calibrated. The power given by the wheel was estimated by means of an absorption brake and a revolution counter. The shaft was provided with an 18-in. diameter brake wheel of special design, and the power was taken off this. In the earlier trials the brake consisted of one or more cords embracing a suitable arc of the periphery of the brake wheel, and having spring balances attached to the tight and slack ends to indicate the corresponding tensions in the cord. As the power varied slightly all the time, both readings were taken at intervals of one or two minutes, and the means used in calculating the final result of the trial. Later a direct-reading, self-adjusting brake, designed by Mr. Withycombe, was substituted for the cords and spring balances with very satisfactory results.

An ordinary revolution counter was used, but arranged to be thrown in and out of engagement with the shaft at the beginning and end of each trial. The necessary readings could thus be made at leisure, ensuring greater accuracy.

In addition to the revolution counter a tachometer was connected to the shaft. This served as a guide when adjusting the load on the brake wheel previous to a trial to give a desired speed of running. It also served to indicate any considerable departure from the intended speed which might take place during a trial, and which would vitiate the accuracy of the calculated results.

Before passing to the examination of the experimental results of the trials, it may be well to make a brief theoretical analysis of the subject. The elementary theory of an impulse wheel is very simple—so simple, indeed, that no attempt seems to have been made to consider to what extent known and observable phenomena may modify theoretical calculations; but rather the elementary theoretical result is generally taken as the last word which can be said on the subject from a theoretical point of view.

In the following investigation the efficiency is deduced from a consideration of the circumstances, as far as they can be mathematically expressed, under which the mechanical action takes place.

In the elementary theory of the impulse water wheel the assumptions generally made are substantially as follows:

1. That the jet has the theoretical velocity due to the available head of water. 2. That the jet strikes the vane centrally and tangentially to the wheel. 3. That the jet passes over the surface of the vane without any loss of relative velocity. 4. That the vane is so formed as to turn the stream through an angle of 180 deg. completely back on itself.

(To be Continued.)

FIRES AND FIRE-PROOF CONSTRUCTION.

Editor CANADIAN ENGINEER:

SIR,—I have, as requested, looked through the pamphlet you were kind enough to send me, on the Paris Charity Bazar Fire, by Arch. E. O. Sachs, author of Fires and Public Entertainments, Modern Opera Houses and Theatres, etc.

This paper was prepared by the author for the Architectural Association, and read at its second ordinary meeting, session of 1897 98, Hampden W. Pratt, F.R.I.B.A., president, in the chair, and was commented on after its reading by Richard Roberts, L.C.C., vice-chairman Theatres Committee, London County Council; Sid. Gamble, A M.-Inst. C.E., F.S.I., second officer Metropolitan Fire Brigade; Major Fox, chief officer Salvage Corps; Thomas Blashill, F.R.I., B.A., F.S.I., superintending architect London Common Council; Capt. Dyson, chief officer Windsor Fire Brigade; William Archer; Henry Lovegrove, A.R.I.B.A., F.S.I., district surveyor for Shoreditch; Max Clarke, A.R.I.B.A. It has been published by the British Fire Prevention Committee, C. and E. Layton, publishers, Farringdon street, London.

I find the consensus of opinion in this case to be that while the fire was caused by an explosion of some of the essential oils used in the exhibition of the Kinemetographic views, the conflagration and the destruction of the building were disastrously hastened by the fact of the roof drapery having been immediately ignited by the explosion, the flames in an instant running along the whole building, some 300 feet in length by about 40 in breadth, setting fire to the woodwork and flimsy paper and other decorations of the interior, which, falling from above directly onto the heads of the lightly-clad ladies in attendance, set fire to their hair, their head gear and dresses, thus causing the simultaneous and almost instantaneous death of 124 persons on whose heads and shoulders at the same time the broken glass from the continuous skylight was falling, cutting into their flesh and inflicting painful wounds and bruises. Still, quick as the destructive element was in bringing about this most terrible result, the committee is of opinion that had the several emergency doors which were barred and bolted at the time, been opened as they should have been by persons told off in advance to do the duty, not one half of the fatalities would have occurred, maybe not one tenth of them, as the victims issuing into the open could have been cared for by outsiders, who would have seen to the safety of all of them and have probably reduced the casualties in most cases to more or less severe injuries to be got over in course of time.

Mr. Sachs recalled the Vienna Ring Theatre fire of 1881, with its 450 fatalities; the Opera Comique fire in 1887, with a death roll of 115, and other great catastrophes; the Exeter theatre fire of 1887, where 160 lives were lost, followed by a serious fire at Oporto with the loss of another 100 lives. He might also have remembered the Bordeaux theatre fire, the Santiago church horror, where 2,000 souls were hurled into eternity, and the Brooklyn theatre fire of 1872 (I believe), where 276 more lives were sacrificed. Mr. Sachs comments upon the fact of how soon these disasters fade from memory, most of them, he says, having been forgotten within from three to seven days of their occurrence.

The London Committee calls on Parliament, or intends doing so, to interfere and force municipalities to attend to the safety of the public by refusing to sanction the erection of such flimsy and dangerous structures and decorations, and I am certainly at one with the committee in refusing to understand how it is to be considered as interfering with the individual liberty and action to enact such laws, any more than legislating on compulsory vaccination and other hygienic safeguards to the public health; for, as above set forth, there is no doubt that, had not the incriminating ceiling cloths been there, or one of asbestos or other inflammable material, and parties at hand to open the seven doors of the building aggregating some 40 feet in width, the Charity Bazar horror would not have been to any extent as serious as it has proved to be.

(Continued on Page xv.)

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For the CANADIAN ENGINEER.

MUNICIPAL OWNERSHIP.

BY RODERICK J. PARKE.

The discussion of this interesting and important question has during the past few years called forth arguments so varied and so numerous that to the non-technical, although directly interested, citizen, the matter has assumed of late a more or less chaotic condition, and a satisfactory solution seems to be no nearer achievement than formerly. For the benefit of those who have been unable to follow the arguments through the columns of the various technical journals, the writer will endeavor to present as briefly and clearly as he can the principal considerations influencing the agitations for and against, and the actual control of, municipal industrial services, and more particularly that branch of the services which embraces the supplying of electrical current for street lighting and private consumers' purposes. This article is not intended to advocate municipal in preference to private ownership, or vice versa, but merely to place before the reader those facts which will have to be carefully considered before an intelligent, unprejudiced conclusion can be arrived at respecting either form of ownership, to the possible exclusion of the other, in those localities in which the question may arise.

To present the subject in a proper light, it is necessary to first ask and answer this question, namely, "What are the principal motives prompting the increasing agitations in favor of municipal ownership? The answer is found to be: (1) The prospect of reducing the cost to taxpayers and private consumers for street and private lighting services. Other motives in the order of their importances are: (2) That the municipality should avail itself of the profits of commercial services, for obvious reasons; (3) Dissatisfaction with the service as rendered by the local company; (4) Local political considerations, and less frequently, purely personal motives among some certain citizens.

Granting, then, that the first-mentioned motive is the prime one influencing the agitation, the question resolves itself not as to who should own the source of supply, but as to whether a cheaper and more efficient public and private service cannot be obtained, and if so, at what proportionate reduction on present cost. Present results show beyond the possibility of a doubt that, giving the same conditions as formerly, in reference to population, cost of fuel and other local conditions, electrical current can be profitably supplied at in some cases a very considerable reduction to the consumer, if modern methods and apparatus be adopted by the central station manager. Competent authorities emphatically point to the fact that if it can be shown that private enterprise can supply municipal industrial services as cheaply and economically as through municipal ownership, very few will be disposed to question the policy of permitting private ownership to continue, providing, of course, that the private corporation will accede to the popular demand. Unfortunately, however, the local company, secure in the monopoly it holds, more often exhibits an utter disregard for the rights of the public, hence the movement for supplying a remedy through municipal ownership. Other reasons for this disregard are lack of enterprise and ability on the part of those responsible for the inefficient and unprofitable condition of the system. In villages and the smaller towns, however, where the demand is necessarily confined within certain limits, the cost of manufacturing is proportionately higher, even with the most efficient machinery, than is the case in the larger towns and cities, hence the public should exercise careful discretion when attempting to compare prices existing in any two localities having a marked difference in population. The individual commercial conditions should also be carefully compared.

The public has every right to demand in return for the privileges accorded to the private corporation in the locality, that the service shall be rendered in the best manner known to be commercially practicable, and at the lowest reasonably profitable prices. Failing in this, the owners of the system can have no cause for complaint in the event of the municipality taking the matter into its own hands, as already illustrated in a number of cases. The question now comes up, whether the company is giving a sufficiently good service to the municipality and at the lowest consistent prices. On this question a great many differences of opinion are found to exist among those directly interested, the only apparent method of arriving at an exact estimate being to have the methods and operations of the system carefully investigated by a board of competent and thoroughly disinterested electrical experts appointed one from each side, and a third chosen mutually by the first two. In this way, assuming the rigid integrity of the experts, the municipality and the company cannot fail

in having their respective interests protected fully and impartially, and a mutually profitable and agreeable understanding promoted. If the results of the investigation show that improvement is warranted and feasible, then let such improvement be made. There should be no reason why central stations should be behind the times, or be commercial failures any more than other industrial enterprises, and if through any avoidable mistakes or errors the owners persist in forcing an unsatisfactory and needlessly expensive service on the community, it is plainly the duty of the citizens of that community to endeavor to set matters on a better basis. And conversely, if the company honestly will make every effort to do its work well and in good faith, it certainly has every right to expect and demand good faith from the municipality.

In the majority of instances of disagreements existing between municipal authorities and the central station owners, the trouble is due in a great measure to misconceptions and exaggerated ideas arising through technical ignorance on the part of the former, and often a mutual distrust of the other's intentions and motives, on the part of both, with consequently disastrous results to the vested interests of the owners when the power of a majority is taken advantage of by the municipality. To instruct the authorities sufficiently to enable them to conduct an impartial and competent inquiry into the workings and methods in vogue in the local central station is out of the question, while to expect them to blindly accept the arguments and statements of the owners is in the majority of instances equally inadmissible. The establishment of a provincial board of industrial commissioners, capable of technically inquiring into and competently advising municipalities on such matters, would seem to be the most advantageous method for all concerned, or, in the event of there being insufficient necessity for the permanent existence of such a board, a temporary one could be drawn from among the ranks of those disinterested members of the electrical profession making a specialty of works of this nature. The central station owners where they have not legally forfeited the right to expect leniency and consideration at the hands of the municipality should certainly have due regard shown their interests as far as can be consistently done, in view of the fact that at the time when the station was established, assuming this to have taken place not less than five years ago, comparatively much inferior and more inefficient methods and apparatus were taken advantage of as being the best then known. In those instances where during the profitable operation of the central station for a period of several years, the owners have shown culpable lack of enterprise in failing to improve the particular system where such would be necessary in order to assure the supplying of an increasingly efficient and up-to-date service at proportionately lower prices, the justice of compelling the municipality to repay to the owners their original outlay for the equipment, is open to serious question, particularly if that equipment be out of date, insufficient, and in a badly depreciated condition. And even though the owners be willing to accept a considerably reduced price for their equipment, the fact must be borne in mind that in order to place such on a modern and more efficient basis the only alternative left is that accepted by the wide-awake manager, namely, to discard the old and install more capacious and efficient machinery and to practically reconstruct the system. Where any part or portion of the old equipment can be advantageously continued in use as a part of the new system, a reasonable allowance should be made on such to the owners, and that part or portion adopted. The tendency, however, seems to be in the majority of cases to ignore the owners as far as possible, and to purchase an entirely new outfit. Whether this policy be a judicious one depends altogether on the nature and quality of the local system to be supplanted, and will be discussed in a future article. It may be remarked just here, however, that a great deal of the machinery and apparatus installed a few years ago would be dear at any price if adopted in a modern central station, where the latest types and highest quality of equipment are necessary to meet the conditions under which the station should be operated. The enterprising manager, alive to his own interests, has already perceived the necessity of operating his equipment under the most economical methods, and that in order to do this the many needless and avoidable wastes of power in process of translating the energy of the coal pile into light and motive power due to poorly designed and inefficient devices must be stopped, as far as the latest developments of the science have shown to be practicable. In consequence of this the said devices have been disposed of to the dealer in second-hand apparatus, or sent to the scrap heap, and the more efficient apparatus installed. If, then, the practical manager finds it to his interests to get rid of his out-of-date machinery, is there any valid excuse for compelling the municipality to cover the losses incurred through the incompetent manager's failure, when it is found necessary or advisable to establish an improved system on its own account, and where in any event the old system would have to be replaced by a new one ?

An article of much interest, bearing on up-to-date management of public lighting plants, appears in the editorial columns of the Electrical Engineer of May 26th, 1898, and is well worth reproduction, in view of the fact that this journal actively opposes municipal ownership. This article, entitled "An Object Lesson for Municipal Plant Advocates," says :—

"It is now about ten years ago that the then Mayor Grant of New York ordered the electric light poles of this city to be hacked down with axes and the wire carted to the city junk yard. This policy of violence was the first step toward the placing of the wires underground, and although no one would now go back to overhead wires, the method adopted for bringing about the result will always be considered arbitrary and uncalled for. In striking contrast with the ex-mayor's procedure is the painstaking and intelligent manner in which the officials of Providence, R.I., have gone about adjusting questions of this kind with the local lighting contractors, the Narraganset Electric Lighting Company. The latter company has an exclusive franchise for electric lighting in the city, but instead of abusing its privilege, has steadily increased its hold on the public confidence by its policy of fair dealing emphasized by a steady reduction in rates. Recently a committee of the city council was appointed to report upon the placing of high tension wires underground, and the committee's report now lies before us. Before formulating its report the committee undertook a trip of inspection of underground work in various cities, and that it was not a junket is evident from the fact that the committee traveled at its own expense. The proposition which it sanctions for adoption by the city council is substantially that submitted by the electric lighting company. This contract provides for the gradual removal within three years of all the overhead wires and their placing in underground conduits within what is termed the first building district of the city. At the same time the lighting company agrees to a gradual reduction of the price for lighting from 35 cents to 30 cents, to take effect in 1903, for 2,000

c.p. arc lights burning 4,000 hours per year. Considering the expense which the burying of the wires will entail, the rate just quoted will be conceded to be very low—one indeed that will require the highest economy in all departments of station work. But President Perry of the Narraganset Co. has always had a reputation for wanting the best that money can procure, and we doubt not that under his management the company will, as heretofore, remain among the most substantial electric lighting properties in the country. At the same time we must express our gratification in these days of municipal ownership agitation that the city council of Providence has among its members men who are sufficiently intelligent and patriotic to weigh and determine the questions submitted to them in a spirit of fairness to the interests both of their constituents and of their lighting contractors. We feel certain that if every city in the Union had adopted the arrangement entered into by the city of Providence and the Narraganset Electric Lighting Co., by which the latter is limited to a profit of eight per cent. on its share capital in lieu of the grant to it of an exclusive franchise, very little would now be heard of municipal ownership of electric lighting plants in this country."

If, as shown in the above instance, the manager of a large and influential electric lighting company has found it much more to the interests of all concerned to endeavor to please the public as far as he can, instead of abusing the privileges accorded him, is it not apparent that for those cases where disputes are now in progress between the municipality and the local lighting company every possible effort should be made towards effecting an amicable settlement, before arbitrary measures are resorted to by the former? Not only in this one instance, but in numerous others as well, have the beneficial results of intelligent, impartial and amicable investigation been clearly and conclusively demonstrated, and there can be no doubt that if the company will show due consideration for the rights of the public at every available opportunity, the latter will not be slow to accord privileges and favors, which under less agreeable circumstance would be denied, perhaps with much indignation.

Where negotiations are to be made between the municipality and the company, the latter has every right to demand that those appointed to advocate the interests of the former, shall be men whom, as far as possible, are capable of conducting an intelligent and competent inquiry, without prejudice to the rights involved, and as the public demand full justice, sometimes with unnecessary vehemence, let them consistently endeavor to provide that justice, in the strictest sense of the term, shall be obtained, not only for the one side, but for both.

(To be continued.)

—Now that Anglo-Saxon unity is becoming a favorite catch word with such as are in high places watching to see which way the wind blows, the people of Toronto are beginning to realize the benefits they have unwittingly conferred upon the Empire and the race by allowing Architect Lennox his own sweet way in building the city hall. Such a combination as it is of Canadian hard-earned gold and United States ready-made fixtures and materials will be a monument to our desire to freely give and take as our neighbor sees fit. Having provided such a monument, we hope that the corpse of the desire will be carefully interred under it, and that in future when Canadian manufacturers tender at less prices than their neighbors for articles of the same class, their tenders may not be rejected merely because the tenderers are not aliens and their wares are not made in the United States.

A POLE RAILWAY.

From Weymouth, N.S., to Nouvelle France, a distance of sixteen miles, there is a railway whose construction and equipment are of great interest to the lumber trade, and in fact to all who are engaged in opening up new or sparsely settled districts. This pole railway was

A Pole Railway in Operation.

built by Emile Stehelin, of Nouvelle France, N.S., who has kindly given The Canadian Engineer some details of this novel work. The line serves six stations in its course: Nouvelle France; Doyle Lake, where there is one sawmill; Riverdale, where there are two sawmills; Woodville, where there are three sawmills; Corberrie, a thriving little village, and Weymouth on the coast.

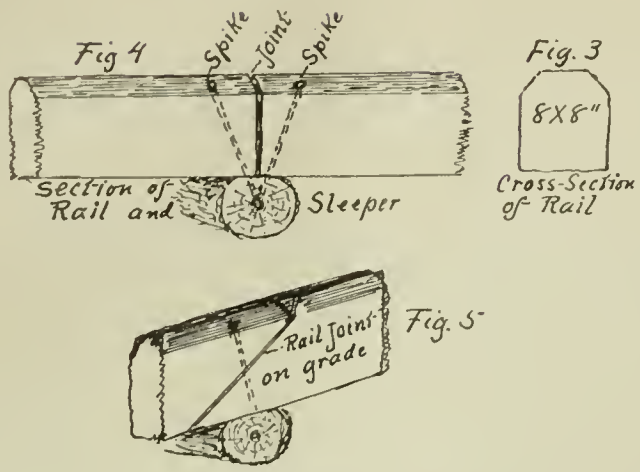
On level ground the construction of a pole railway is a very easy matter, but in this part of Nova Scotia the country is hilly and there are a great many swampy stretches which made construction more expensive than would often be the case. The cost of the whole line, including equipment in this case, was about $3,000 per mile. This included grades of three to six per cent., a number of bridges and several embankments of from ten to fifteen feet high. On level ground the construction con-

A Pole Railway—Construction.

sists in laying down sleepers ten feet long and three to four feet apart, on which is laid a spruce rail, sawn as shown in Fig. 3. The rails are twenty to thirty-five feet long, and are trimmed square for flat stretches and bevelled for grades as shown in Figs. 4 and 5. The joints are made and the rails secured by twelve-inch wharf spikes as shown.

The method followed in building bridges and embankments is to lay a series of timber floors one upon another, each at right angles from the last, till the required height of the pier of embankment is obtained. With careful work and exact cutting of the timber, there is practically no limit to

the height to which such piers and abutments can be carried.



The locomotive "Firefly," shown below, is the one first used by the road. This is an old stationary boiler and a twenty horse-power engine, mounted on a truck. The wheels are driven by an intermediate crank wheel. Considerable difficulty was experienced in adjusting the parts of this engine, but it was finally got to run very satisfactorily, and is used for hauling logs to the sawmills.

A Pole Railway—The Locomotive "Firefly."

The "Maria Theresa," shown below, is an entirely new locomotive, built expressly for the line by a Nova Scotia firm. It has four cylinders of twenty horse-power each, driving two trucks of four wheels each.

In operating a line of this kind, one of the greatest difficulties to be contended with is the amount of friction developed by the wheels, which do not run on the wooden rails with at all the same ease as on steel or iron. The

A Pole Railway—The Locomotive "Maria Theresa."

locomotive should, therefore, be made as light as is consistent with the power to be developed, the friction of the wheels being sufficient to compensate for the lack of weight in the locomotive. It is to obviate as much of this friction as possible that the upper surface of the rail is cut in three faces. At present, only six miles per hour is obtained regularly, but Mr. Stehelin hopes with some modification of the locomotive wheels to obtain higher speeds. The engines are wood burning, but it is proposed to substitute coal, which can be had very cheaply at Weymouth. The freight cars used on the pole railway are twenty feet long on two trucks with four wheels each; the passenger car is twenty feet long, and is covered and closed; there is also one small passenger car to carry four persons.

CHROMIC IRON IN CANADA.*

For a long time chromic iron was regarded only as a mineralogical curiosity, and its industrial use only became known when it was applied to chemical industries. The application of the salts of chrome to dyeing dates from 1820, and the industry of the manufacture of bichromate of potash was inaugurated about that time. It was only in 1883 that potash was partially replaced by soda. Down to 1827, the very limited consumption of this product was supplied from the region of the Ural Mountains. In 1827, chromic iron was discovered by Isaac Tyson, jr., in the neighborhood of Baltimore, and subsequent search resulted in further discoveries of it in other parts of Maryland and Pennsylvania. From that time to 1862 the Baltimore region supplied the market in the United States and Europe, the most important centre of consumption in the latter being Glasgow. In 1845, Mr. Tyson, in order to utilize his surplus output, established the manufacture of bichromate of potash, which is still in operation in Baltimore under his direction. In 1848, the deposits in Asia Minor were discovered, which, ten years later, became, so to say, the most important factor in the production of chrome in the whole world. In 1869, discoveries of the ore were made in California, which have supplied the American industry from 1878 down to these latter years, and next in New South Wales and New Caledonia, and lastly in Canada and Newfoundland in 1894.

Chromic iron, or chromite, has a density of 4, 5, say about 7 cubic feet per ton, its hardness is between 5 and 6, it gives a brown stripe and dust; it is unattackable by acids and infusible at the highest temperatures. Some authors say that it is sometimes magnetic, but J. Obalski, M.E., in describing the deposits in Quebec, did not observe that it was so in that region. It is true that some samples of magnetic iron in the serpentine contain chrome, but, at least for the Quebec district, its non-magnetic condition is a distinguishing characteristic of ores that can be worked for chrome; its appearance moreover is that of magnetic iron or titanic iron. It is composed of iron in the state of protoxide and sesquioxide of chromium; nevertheless the elements, iron and chrome may be, in part, replaced by magnesia and alumina, which then reduce its grade, without prejudice to the mixture with the serpentine, which is moreover easy to discern. Theoretically it may be said that the yield in sesquioxide is 68 per cent., but it is rare for the real grade to exceed 56 or 57 in picked specimens, and the industrial tests on shipments very seldom reach 53 or 54. The merchantable grade for the manufacture of bichromate of potash is 50, but some buyers accept 49 and even 48. Under that, the ore is classed as of inferior quality. The Black Lake ores have given 49.8 and 50.3 on shipments (analyses of the Baltimore chrome works), and 54 and 56 on specimens (Donald analyses) 58.06 (Pittsburg testing laboratory), concentrated specimens from Black Lake 56.28 and 60.66 per cent. (Ledoux &

*The facts here presented are taken from a recent report by J. Obalski, M E Provincial Inspector of Mines for Quebec.

Co.). Milton L. Hersey has also made numerous analyses of these ores, which frequently gave high grade. Shipments from Breeches Lake have reached 55 per cent. In chemical industry, the ores which are poor in silica are preferred, and for certain uses buyers fix a limit of 12½ per cent. of metallic iron and 8 per cent. of silica.

The existence of chromic iron in the serpentines of the Eastern Townships, of Quebec, has long been known, but until 1894 hardly any effort was made to develop the deposits. According to the geology of Canada for 1863, the first attempt in that direction was made in 1861, when about ten tons were extracted in the neighborhood of Lake Nicolet. Some twelve years ago, a small quantity was also taken out in lot III, 24 of Wolfestown, and in 1887 Dr. J. Reed shipped to Philadelphia 54 tons derived from lot X, 1 of Leeds. Lot IV, 16 of Thetford, also yielded four or five tons, but of low grade. About the same time, specimens sent to Antwerp Exhibition had attracted attention, and orders for ore had been received, but the known deposits did not appear to be rich enough to be worked with profit. In April, 1894, an unknown mineral having been discovered near Black Lake by a man named Provençal, a specimen of it was brought to the office of the Provincial Mining Engineer, who at once recognized it as chromic iron of a high grade, and advised that the mine should be worked, indicating at the same time where a market could be found for the product. The Nadeau-Provençal mine was thereupon opened; and the selling price of the ore being deemed remunerative, prospectors entered the field and other discoveries were made in the neighborhood, especially in the township of Colraine, thus giving rise to an industry which promises to become prosperous.

The presence of these deposits is indicated by a sort of black spongy crust, of ferruginous aspect, appearing in spots on the serpentine and by the loose rocks found on the surface. Sometimes the crusts are only superficial, and at others they penetrate into the serpentine with a thickness of several inches, which may increase and attain several feet. In still other cases, the mineral shows itself at once on the surface with its metallic aspect and occasionally in its greatest thickness. But the deposits have a character of irregularity; they seem to be almost independent of each other, and sometimes suddenly disappear without leaving any trace to warrant further work. No defined walls except the planes of ordinary fracture in the serpentine are observable. The question of the depth to which these deposits extend has been mooted, and it has even been suggested that borings should be made to determine whether they cannot be found where they do not outcrop at the surface. Such deposits should exist and chromic iron has been found at a depth of 30 feet in an otherwise unproductive shaft sunk for asbestos by the Beaver Asbestos Co. on lot Colraine C. 30. Geologists have given considerable study to the origin of this mineral, and have established, in the Quebec region at least, that while it occurs in the dark green serpentines of the Eastern Townships, it is absent from the buff or honey-colored serpentines of the Laurentian system.

Chromic iron is also further found on the west coast of Newfoundland, at Bluff Head, Port au Port Bay, where a very important bed is being worked by the Halifax Chrome Company, which during the summer of 1896 took out 1,500 tons and shipped about 200 gross tons, of which 145 went to Pittsburg, where it yielded 49.90 per cent. (Transactions of the American Institute of Mining Engineers, Geo. W. Maynard). The author of this paper says that the ore gives from 39 to 50 per cent., and he mentions the discovery of a mass 97 feet long by 45 feet wide.

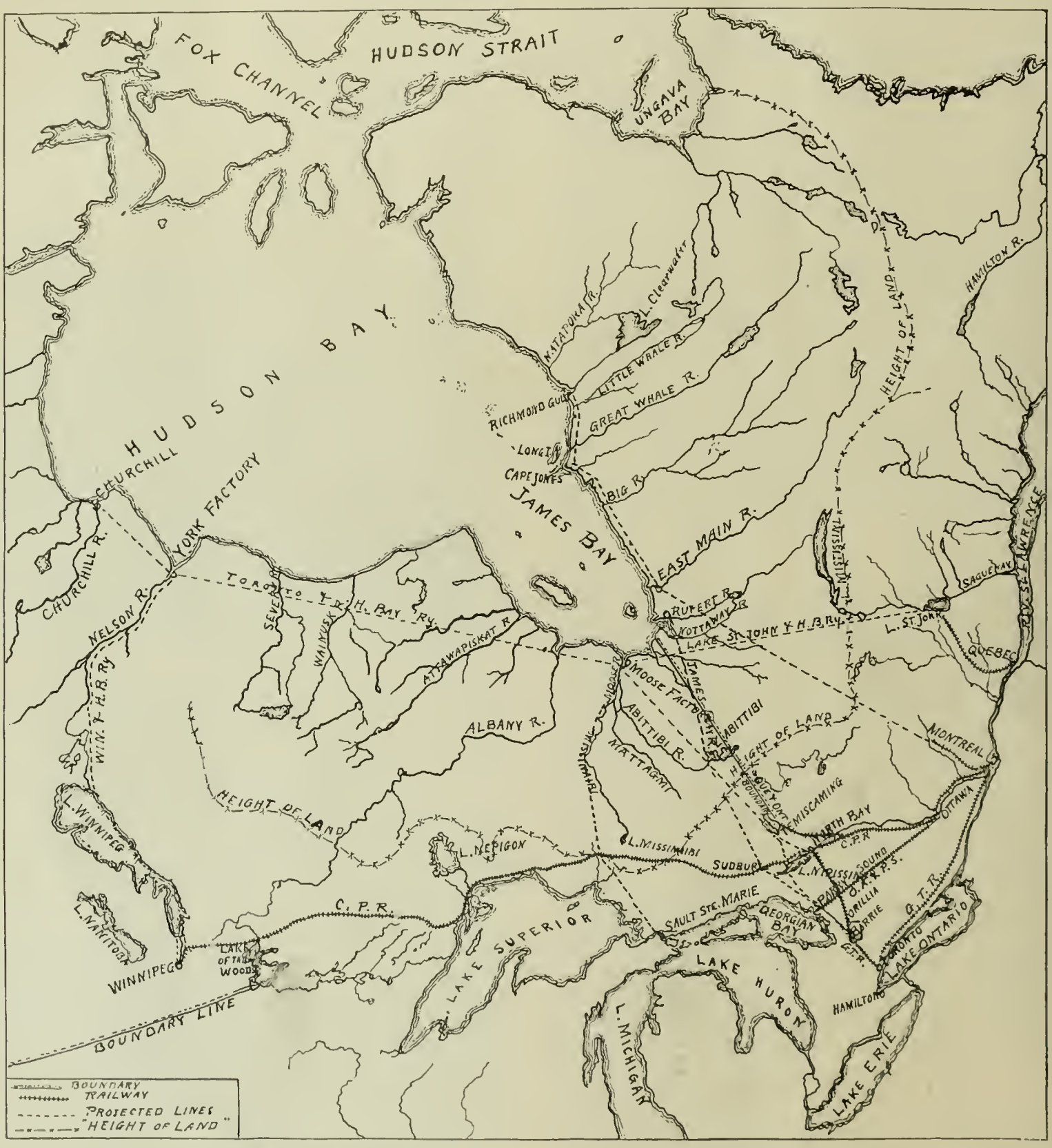
With these deposits in Canada, there seems no reason why a great chemical industry should not be built up in Canada, along with a considerable addition to our mining development. Chromic iron is used for the manufacture of bichromates of potash and soda, which are employed in the dyeing and printing of calicoes. These products form the bases of the chrome colors, yellow, orange, green, etc.; they are also utilized in the construction of certain batteries of electric piles, in the tanning of leather, in chemistry, and slightly in medicine. Chrome enters into the composition of the ferro-chromes, which are used to make the chrome steels that are noted for their very great hardness, and employed for the armor plating of vessels and forts, and for the making of shells, tools for cutting iron, shoes and dies in stamp mills, safes, etc. Ferro-chromes of different grades, ranging from 40 to 90 per cent. of chrome, are made while the chrome steels contain from 1 to 10 per cent. of chrome. They are also employed in alloys with aluminium. Chrome imparts to the metals with which it is allied great hardness and inalterability, and increases their elasticity, these qualities varying with the grade in chrome. More recently low-grade chromic iron has been employed on account of its essentially refractory qualities, in the construction of certain parts of furnaces exposed to high temperatures, and especially in the construction of the inside parts of open hearth furnaces and of reverberatory furnaces for copper smelting. A certain quantity of it is regularly used for this purpose in the Pittsburg district, where also special chrome fire bricks are manufactured, two companies being engaged in this industry. In this case, the medium grades are preferred, on account of the price. In latter years about 2,000 tons have been used in the United States for these purposes. It is also employed by the European metallurgical establishments.

In the Province of Quebec there is a pretty extensive region in which chromic iron occurs in commercially workable quantities, and when it is considered that these deposits are located at distances ranging from several acres to five and nine miles from the line of the Quebec Central Railway, and on heights which render their working easy, that labor on the spot is cheap and fuel wood close at hand, it would appear that it would be difficult to find a more favored country as regards this industry. It has been prosecuted there since 1894, but by very primitive methods, not a single steam machine having been yet employed; nevertheless over 10,000 tons have been taken out to a value of about $140,000. Nova Scotia coal is worth $4 a ton at the Quebec Central Railway. Furthermore, the chromic iron ores of the region in question are concentratable and capable of furnishing a very large quantity of high grade. The Government still owns many lots, which can be fully bought out at $400 per 100 acres. There have been no deep workings yet, and it is safe to conclude from what has been said that this district is destined to become an important factor in the production of chromic iron for many years to come.

ON TO HUDSON BAY.

Hudson Bay, Canada's great inland sea, is about 600 miles across from east to west, and measures about the same distance from north to south, or if you include James' Bay, its southern arm, it will be 1,300 miles long from its northern to its southern extremity. Its average depth is 600 feet, and its floor is so level and uniform that if it were raised out of the water it would form one vast prairie

like that of Manitoba. The waters of James' Bay, however, are so shallow (except through one wide channel leading down its centre to Moose Factory), that a boat oar can touch bottom many miles from shore. This vast inland ocean is a basin into which 3,000,000 square miles of land are drained, and so large is the quantity of fresh water pouring down, that the waters of James Bay are only slightly salty. Hudson and James Bays receive the waters of twenty-five large rivers besides those of numbers of smaller rivers, some of which are unknown and unnamed. Notwithstanding the vast area of Hudson Bay (about 500,000 square miles), no part of it is within the Arctic Circle. The resources of this vast region are climatic features of the great inland basin as to discourage inquiry. Hence it is that many intelligent Canadians imagine that the waters of Hudson Bay form one immense ice field during the greater part of the year. As a matter of fact, Hudson Bay itself is never frozen over any more than Lake Huron or Lake Superior. Navigation can be carried on throughout Hudson Bay proper every day in the year. It is only in Hudson Strait that difficulty from ice is encountered. In James Bay, owing to the shallowness and freshness of the water, ice is formed during the winter, but this ice with the river ice breaks up in April and May at about the same date that the St. Lawrence River is free from ice. The trouble



only now being faintly realized. We now wonder that the natural fertility of Manitoba and the North-West Territories, and the great mineral resources of British Columbia and the Yukon, remained so long unknown, or, at least, unappreciated by the people of the older Provinces. In a few years when the great valley of James and Hudson Bays shall have been opened up by railways, we will wonder still more that it, too, should have remained so long locked up. The reports of early travelers and explorers, who, in order to make interesting stories, have exaggerated the character of the climate, have no doubt been one of the stumbling blocks in the way of opening up our great northern land. The climate and surroundings of Hudson Straits also have been so confounded with the in navigating Hudson Strait is not from locally formed ice, but the great polar ice fields that are annually broken up and drift down Davis Strait and Fox Channel, where quantities of it are deflected by the inset of the Atlantic tides and turned into the Strait. The length of time when the Hudson Straits are navigable, varies according to different navigators and explorers all the way from $3\frac{1}{2}$ to $6\frac{1}{2}$ months in the year. Notwithstanding the pessimistic views of many regarding these Northern waters, the fact remains that though Hudson Bay and Strait have been navigated continuously since 1668, when the Hudson Bay Company was formed, the shipping disasters have been remarkably few, so few indeed that for the last half century the Hudson Bay Company has ceased to pay insurance on

its vessels, having found it cheaper to assume its own risk. Dr. Bell, the Dominion Government explorer, agreed with the reports of those who have spent years in residence on the shores of the Hudson Bay, that these waters are remarkably free from violent storms, particularly in summer months. Taking all months of the year together, the Hudson Bay is a mill pond compared with the north Atlantic, while the total hours of fog in the year are only one-third those of that part of the Atlantic through which most of our present ocean steamship tracks are mapped. These are important points which are now beginning to be realized by Canadians.

When we come to the question of climate, we must remember that we are dealing with a stretch of country nearly 2,000 miles from north to south if you take the Height of Land of northern Ontario and Quebec as its southern boundary. There must of course be a considerable variety of climate in so large an area. Taking the country from the Height of Land to the northern part of the James Bay on both the east and west sides, we have the most positive evidence of a climate as temperate and healthful as any part of the St. Lawrence Valley or that part of Ontario between the Ottawa and Georgian Bay. The voyageurs who accompanied some of the Dominion Government explorers to the James Bay were surprised at the mildness of the climate and the high summer temperatures of the water, compared with their experiences along the shores of Lake Superior where most of their life had been spent. This is accounted for partly by the greater length of the summer day in these northern regions and partly by its nearness to the level of the sea. Dr. Bell found the average temperature of sea along the east coast of the Hudson Bay to be 53 degrees Fah. and of the rivers 61 degrees, and he and his party bathed in the sea almost daily on their journeyings along the coast. The various farm and garden products that have been grown for the last half century or more by the Hudson Bay factors and the missionaries around the Bay, and the character of the forests, are further evidences of the suitability of the climate for successful settlement. Starting from the Height of Land in either Ontario or Quebec, the traveler passes through an extensive shallow basin, comprising not only vast tracts of splendid agricultural land, but numberless lakes of all sizes linked together by rivers and streams. From the northern rim of this broad basin the land again slopes gently towards the shore of James and Hudson Bays, cut through here and there by rivers. These numerous rivers, though navigable for stretches 100 miles or more, have numbers of falls and rapids, which, while they are an impediment to navigation, give promise of immense industrial advantages in the creation of water powers. On the Abittibi one exploring party had to make 21 portages, owing to the rapids, falls or chutes, some of which could be transformed into ideal water powers. There is probably no similar area of country in the wide world capable of yielding such an enormous amount of water power for industrial purposes. Right here we may say, that in view of the illimitable area of splendid spruce land and cheap power in this region a railway through the Hudson Bay Territory could be made a profitable investment if the wood-pulp industry alone were in question. The finest spruce in the world is to be had in these northern forests, the extent of which is beyond estimation. White and black spruce and the larch tree thrive well up to a point north of Richmond Gulf, and when this line is carried some distance inland eastward it again curves north to Lat. 59, or to a point north of Cape Dufferin. Balsam, poplar, canoe birch, aspen, mountain ash, balsam fir, bird cherry and Banksian pine, have their northern limits at various points farther south on the shores of the James Bay, but in each case this limit is also extended farther north as you go inland to the east and west of the Bay. The white cedar, mountain maple, white and red pine, white elm, red oak, ironwood, basswood, birch, ash, and other deciduous trees are to be found in areas of varying extent from the head of James Bay down to the settled districts of Ontario and Quebec. J. C. Bailey, who was on the exploration for the Nipissing and James Bay Railway, found splendid specimens of Norway pine, yellow and black birch, and sugar maple, many trees measuring from 20 to 40 inches in diameter, and standing 70 to 80 feet high. As to the soil, almost every traveler and explorer has been surprised at its fertility and the depth of vegetable mould. Dr. Bell, in his report to the Government on the country between Lake Superior and James Bay, says: "After passing the 'swampy grounds,' the traveler cannot fail to be struck by the abundance and fertility of the soil exposed on the banks of the rivers all the way to Moose Factory. I have no doubt that at some future time this country will support a large population." Among the agricultural products that have been grown year after year at various Hudson Bay Company's posts, and by missionaries living among the Indians, may be noted barley, oats, rye, peas, beans, melons, cucumbers, castor oil beans, tobacco, balsams, cauliflowers, cabbages, lettuce, turnips, radishes, beets, carrots, onions, coleworts, cranberries, gooseberries, currants, strawberries, raspberries and cherries. Wheat has also been grown at the Hudson Bay posts. Sarsaparilla of a very superior quality grows wild over a wide area of country. Archbishop Tache gives at least 223 species of birds, and 72 species of fur-bearing animals to be found in this region. The wealth of the Hudson Bay district in fur is too well known to need emphasis here. Agriculture in the Lake Temiscaming and Temagam districts has passed the experimental stage, tracts of land having been brought under cultivation, the farmers finding a market in the supply of men and horses engaged in lumbering operations there. An abundance of hay is grown, the clover of the Temiscaming district being said to to excel that grown in any other part of Canada. Root crops are successfully raised. Of oats, barley and peas the farmers have large harvests; cultivation of wheat is alone limited by the narrowness of the market. All that is wanted to place agriculture in this district upon a well established basis, and open up the rich territory around Lake Abittibi to the north, is efficient railway communication with the commercial centres of the Dominion.

We now come to the mineral features of the Hudson Bay slope, and here it must be remembered that nine-tenths of the country has remained until now absolutely unknown and untouched by the geologist or prospector. The cursory examination of this one-tenth of the region in question has disclosed the following minerals:—gold, silver, lead, iron (magnetic and hematite), nickel, copper, pyrrhotite, zinc, galena, antimony, arsenic, tellurium, platinum, tin, bismuth, molybdenum, cobalt and manganese, while among the non-metallic minerals may be noted agates, carnelians, epidosite, porphyries, granite, syenite, sandstone, quartzites, flagstones, slates, marbles, ornamental argillites, jaspers, garnets, chalcedony, white quartzites for glass making, asbestos, graphite, actinolite, lithographic stone, gypsum, salt, amethysts, soapstone, ochres and other mineral paint material, kaolin, lignite, mica, peat, axinite, limestones, brick clays, petroleum, and last of all anthracite. When we consider how slight has been the geological examination of this region, the foregoing list is certainly imposing, and of the minerals here enumerated

NEW VICTORIA JUBILEE BRIDGE ON G.T.R., AT MONTREAL—VIEW FROM HARBOR GUARD PIER.

at least one-half are known to exist in paying quantities. In some cases the deposits are of incalculable extent, and all that is wanted is railway communication to develop them. The copper belt, a large part of which is nickeliferous, extends all the way from Lake Huron and Lake Superior to Lake Mistissini. Antimony was found near Echo Lake in a vein eight inches wide of very rich ore. On Moose River the gypsum beds are ten to twenty feet thick, and have been traced for many miles from the river. Carniferous rocks are extensive to the south west of James Bay, and in this formation it is expected oil will be found, as in like formations in the Enniskillen fields of Ontario. Large deposits of clay iron-stone are found on the Mattagami River. The ornamental stones alluded to in the non-metallic list are found in remarkable abundance in many places, while some beautiful varieties of unnamed ornamental stones have been discovered. Samples of the granites have been polished and are said by experts to be finer than Aberdeen granite. Of the samples of marbles, some are banded, some clouded and all are easy to quarry. Some of the yellow ochres and Venetian red paints have been found in such a condition that they can be used without grinding. A bed of kaolin is found on the Missinaibi, below Coal Brook. It is overlaid by a bed of beautiful bright sand, of which E. B. Borron says, "I believe that both the kaolin and sand, the one suitable for the manufacture of porcelain and the other for window glass, are there in large quantities." Lignite is found on the Mattagami, the Missinaibi, and the Abittibi, and the beds of peat are declared to be "absolutely inexhaustible." Of other beds of lignite, Dr. Bell mentions some that are 1½ to 6 feet thick. The sample of anthracite found on Long Island, and shown to Dr. Bell, has a conchoidal fracture and a bright lustre, and on analysis yielded 94.91 per cent. of fixed carbon, and only 0.35 per cent. of ash. Dr. Bell was prevented from visiting the locality, but this discovery is of the highest importance to both Ontario and Quebec. On the Abittibi River, the bituminous limestones and carbonaceous shales closely resemble the petroleum-bearing strata of the MacKenzie Basin. Mr. Low, who explored the south side of Hudson Straits last year, says "the schistose rocks of that region are frequently penetrated by numerous quartz veins, and their proximity to masses of igneous rock are conditions favorable to the occurrence of gold. Along with this schistose are large beds of impure iron ore, corresponding with the enormous deposits of bedded iron already found in the Cambrian rocks of the Koksoak and Hamilton Rivers." The clay deposits of Lake Abittibi are unusually rich in aluminum, and this industry alone should justify the exploitation of that region. A sample of the manganiferous spathic ironstone, which is found in such great abundance, was shown on analysis to contain 25.44 of metallic iron and over 24 per cent. of carbonate of manganese. A band of chalcedony seven feet thick was found by Dr. Bell on one of the islands north of Richmond Gulf. "The spathic ironstone bands of the whole Nastapoka chain are found by Dr. Harrington to constitute valuable iron ore. These form a band averaging 20 feet thick throughout the whole group of islands, which have a length of about 90 miles exclusive of the islands to the north." The enormous abundance of the ore is its great feature, and we are told that not only is the ore already broken by nature in inexhaustible quantities, but much of it can be loaded direct into vessels from the steep, rocky sides of the islands. Magnetic ironstone is washed out of the drift in considerable quantities at various places along the coast. The rare mineral axinite, which has been discovered near the mouth of the Little Whale River for the first time in Canada, is found in crystals along with quartz, calcspar, epidote, chlorite and asbestos, also in the granular form. It is of purple color and takes a high polish.

This mere outline of the minerals found in the James and Hudson Basins will show that Canada has more than one Klondyke; and when it is considered that only a few years ago the large areas of gold and nickel of northern Ontario were unsuspected by the geologists who had traversed the region, it is but reasonable to expect that new minerals will be found and more expensive deposits of those already known will be unearthed in the region under consideration.

The accompanying sketch map is intended to show approximately the routes of various railway lines projected towards Hudson Bay from Ontario and Quebec. The conformation of the country, the abundance of timber, and numerous water channels, render railway construction in this country a most easy problem. The surveys already made show that the highest grades going north from the Height of Land are not more than 1½ to 1.33, and going south not more than 1 per cent. The total elevation above the sea of this Height of Land averages from 850 to 1,200 feet. Though the road projected from Missinaibi is the shortest, it is perhaps not the one best calculated to bring the resources of these northern latitudes to the marts of Ontario and Quebec. The lines extending from North Bay in the one case, and those projected from Lake St. John or Labelle on the other, are the ones most likely to be looked on with favor by the people of Ontario and Quebec to start upon. The commission, of which W. T. Jennings, C.E., is secretary, appointed by the Toronto city council, has done solid public service by bringing this question forward recently; while the James Bay Railway Company, backed by Senator Geo. A. Cox, Wm. Mackenzie and Geo. H. Bertram, M.P., has obtained a bonus from the Ontario Government, and it is said the Dominion Government has also promised to assist in the undertaking. The citizens of Toronto, along with other Ontario cities, are now awakening to the possibilities of this new land, and one may hope they will no longer deserve the caustic comment of Mr. Paterson, who, in discussing the subject, said: "Many rich Toronto merchants would rather sit down on a few corner lots in the city and wait until they rise in value, and aldermen would rather squabble over putting on or taking off half a mill of taxation, than stir outside and bring in trade." The city of Quebec is taking a lively interest in the subject, largely owing to the persistent advocacy of its city engineer, Charles Baillairge, C.E. It is hoped that both provinces will be emulous in pushing forward enterprises that are so certain to increase their population and develop their trade.

VICTORIA JUBILEE BRIDGE, G.T.R., MONTREAL, IN COURSE OF RECONSTRUCTION—LOOKING DOWN THE ST. LAWRENCE.

For THE CANADIAN ENGINEER.

REPORT ON THE PRECIPITATION SYSTEM OF SEWAGE DISPOSAL IN OPERATION AT HAMILTON, ONT.

BY W. M. WATSON.

During the month of March I visited and made a superficial examination of each of the two sewage works that are intended to clarify the sewage of about 35,000 out of the present population of 50,000 in the city of Hamilton, Ont., leaving the sewage untreated at the outfalls into the bay, at the foot of James street, Stuart street and Queen street, together with the large brick sewer that drains the whole of the mountain slope property and empties into Cootes Paradise. The small works at the east end of the town, on Wentworth street, was built early last year, and it is stated in the engineer's annual report for 1897, that they commenced operations on May 17th. Our readers will find a full description and illustrations of this plant in THE CANADIAN ENGINEER for January, 1897.

It is stated on page 58 of the annual report for last year, that from the date that the Wentworth street works commenced operation to the end of the year, they treated 114,114,000 gallons, or a daily average of 474,000 gallons. When describing the visit of the Toronto aldermen, to inspect the works, it is stated in the Toronto Evening News that the daily run of the sewage works is only ten hours out of the twenty-four each day, which means that only one set of employees is engaged and that for 14 hours each day the sewage passes over the underground overflow weir to the Burlington Bay, raw and untreated. On page 62 of the report it shows that the actual cost of operating the East end works for 220 days from May 17th to end of year was $4,470.87. Law cost, $704.28. The cost of construction and machinery is given at $38,000. The average cost per day for operating with one set of men 10 hours daily will be $20.32, and $7,415.84 for the whole year. Then add four per cent. interest on $38,000, the cost of plant, viz., $1,520, and allow ten per cent. on the wear and depreciation of value of machinery and works, $3,800, brings the annual cost of only clarifying the sewage at that small works for 10 hours each day from a population of about 12,000, and which appears to be void of trade or strong sewage, to $12,736.80, or over $1 per head. Should the works be run night and day, the management expenses would be double, and still the clarified sewage will go into the fresh water, unpurified, and containing most of the injurious and poisonous matter that is discharged from the skin and intestines of living creatures, jeopardizing the health of the inhabitants residing near the waters into which the clarified sewage is discharged, and afterwards setting up putrefaction, assisted by the lime that is used as a precipitant. If the amount treated, as stated in the report, is 474,000 gallons daily, it will amount to 173,010,000 a year, costing about $1 for each 13,600 gallons of sewage said to be clarified.

The works built at the foot of Ferguson ave. are similar in design and management, but are over double the size of the Wentworth street works. They have six settling tanks double the length of the three at the smaller works, and double the amount of machinery and appliances. They cost $42,000 to construct and are said to be capable of clarifying 3,000,000 gallons of sewage daily. We have no data to show the cost of management of these works, but experience would show that they will at least cost forty per cent. more than the works having less than half the capacity. They commenced operations early in March this year, and will be worked with one set of men 10 hours per day, as at the Wentworth street works. If then 3,000,000 gallons arrive at the works daily the average per hour will be 125,000 gallons, and for the 10 hours the works are in operation 1,250,000 gallons of sewage treated and 1,750,000 sent forward to the bay untreated per day. The Hamilton newspapers reported that a test was made by the engineer and part of the committee to prove the amount of sewage that actually came to the works, and they found that it amounted to 2,200,000 gallons per day at the Ferguson ave. works, or 800,000 less than the capacity of the works is stated to be. The population served by the two works is probably about 35,000 and the united cost of operating the two works 10 hours per day will be $30,600 per year, over 87 cents per head of contributory population, and if worked night and day, as they ought to be, the working expense will be double that amount, less interest on capital.

The sewage leaves the sewer and flows to a well, and is then lifted out by centrifugal pumps about 20 feet high and discharged into a wooden trough that leads it to the brick culvert that feeds the settling tanks. During the passage of the sewage from the pumps to the culvert lime an alum solution is dropped into the stream at the rate of 3½ grains of lime and 1½ grains of alum for each gallon of sewage. All the settling tanks stand full of sewage in a quiescent state, and the volume of sewage pumped enters the top of the settling tank through an opening about four feet wide, at a speed to all appearances of about twenty feet per minute, floating over the surface of the fluid at rest in the settling tank to the opposite end, when it passes through a similar opening made in the partition wall between tanks Nos. 1 and 2, then floats back to the commencing end, where it enters tank No. 3 and repeats the process until all the six tanks have been traversed, when it falls into the discharge culvert that is connected with a covered-in drain, which we suppose conveys it to the bay.

We expect that the stream of moving sewage will not sink more than one foot into the quiescent liquid contained in the tanks, or spread out over the surface more than 8 feet, and the rapidity of the flow will prevent the lightest solids held in suspension from settling down, so that the sludge extracted will be chiefly the heavy harmless grit or scouring dirt from roads, yards and floors, and the solids from the sewage that is allowed to rest in a quiescent state

in the tanks, while the bulk is flowing over the top. The alum was observable in the pressed sludge cake which had a clayey feel; but ammonia or urine usual in domestic sewage was not noticeable.

When comparing the sewage entering the tanks with the effluent leaving the last tank, No. 6, there was little difference in the appearance of the two samples, probably, first, because the flow was too rapid; second, because the sewage enters the settling tanks at the top when it ought to enter the bottom; third, because the precipitants are not in sufficient quantity or thoroughly incorporated before they enter the tanks; and, fourth, the lime solution is made from unslacked lime which will cause it to be attracted by the water rather than by the dirt composing the sewage.

We were informed that some improvements would shortly be made, and probably filters added to purify the sewage after clarification, as the engineer has been experimenting with great success in purifying sewage on Mr. Garfield's principle of passing it through pea coal, on the lines laid down in the September issue of THE CANADIAN ENGINEER. The design and arrangements of the works are such that they can perform efficient clarification, and when filters are added and the whole sewage that comes to the works treated and the overflow weir becomes useless, except when a big storm is in progress, then the $80,000 and cost of management will become a reasonable outlay, though just as good results might have been secured at a far more moderate cost.

The culvert carrying the effluent from the tanks to the bay should be open and made broad and shallow, so that the effluent could secure aeration during its progress to the bay and be easily inspected; also the by-pass channels and overflow weir should be open to view, so that they could be easily observed and show when all the sewage was passing through the works. Sewage, during and after treatment, requires all the atmospheric air it can secure. It is hard for a deputation to get at the true value of any sewage works in a two hours' visit, because any works or process can be made to work efficiently for a short period, but the difficulty is increased if the bypass, the discharge channels and overflow weir are not all open to sight. Moreover the assistance of an expert analyst should be had to show the exact contents of the effluent.

As previously stated in articles in THE CANADIAN ENGINEER, to clarify sewage it should remain at rest for some time, and if the continuous flow system be adopted, to save expense of a regular attention, then both ingiving and discharging flow should be thin and very slow, so that the volume of sewage resting is only very slightly disturbed and no perceptible motion created. The flow should be at a rate of about half a foot per minute, entering the full width of the settling tank near the bottom at the deepest end, and overflowing over a level lip the full width at the opposite end, and the quantity allowed to enter should be so regulated that it would be three hours before it reached the overflow. The Hamilton tanks can easily and cheaply be made to work on the continuous flow plan, and they can, as at present arranged, be worked on the quiescent system. Each settling tank would then work separately, as they ought to do, to perform good clarification.

We believe that each of the six long tanks at Ferguson avenue holds about 127,000 gallons; so to clarify 3,000,000 gallons in 24 hours the sewage should enter each tank at the rate of 170 gallons per minute, which would be sufficiently slow when the width of the tanks is taken into account. This should answer almost as well as the quiescent system worked with the float and discharge valves that are attached to each tank. When raw sewage enters at the bottom of a settling tank during the act of rising to the surface the suspended solids are encouraged to stay behind at the bottom.

Lime should not be used as a precipitant when the clarified sewage is discharged unfiltered, because it will not destroy microbes, but rather assist in multiplying them, and after a space of about two days, when the sewage effluent has mixed with fresh water, the lime will assist the clarified sewage to set up putrefaction, and the result will be equal to, if not worse, than would have been the case if the sewage had been well screened and passed in raw and untreated. The most suitable precipitant is stated by Mr. Slater, an expert in the sewage business, to be salts of manganese, which carry down the organic together with the dissolved suspended substances. It also destroys certain impurities by transferring to them a continual supply of oxygen from the atmosphere and from the air in the sewage fluid. This precipitant was expensive, but Mr. Adeney has found a substitute, by utilizing the waste products from certain iron works that are very rich in manganese, and which contain all the valuable properties claimed to be in the manganese compound sold as a sewage precipitant. An equally good precipitant may be made from the rust of iron, from iron ores or the refuse oxide of iron discharged from sulphuric acid works, dissolved by hydrochloric acid, which, when manufactured, is called perchloride of iron; $\frac{3}{4}$ of a pound will precipitate 1,000 gallons, it will never set up decomposition, and has great settling power. It could be made at a cost of $15 per ton.

With reference to the manufacturing of a solution of lime for use as a precipitant, we have found that the lime should first be slacked in thin layers with about 7 per cent. of water sprinkled on with a fine rose sprinkler, just sufficient to cause the lime to separate into fine powder, then bank it up into a heap and cover it over to keep in the steam, and allow it to remain in that position for over a week, or until it becomes thoroughly cooled. Afterwards mix it with the fluid at the rate of two parts fluid to one of lime, and mix it together well, when a solution is produced that is heavy enough to bear down and be attracted by the solids held in suspension by the sewage, and if the lime is delivered into the fluid sewage at the rate of eight grains or over of slacked lime to each gallon of raw sewage, and the lime solution is delivered into the sewage at the point where it enters the works, so that the action of the pumps and sharp angle movements will thoroughly incorporate the lime solution with every particle of sewage in equal proportions, and then the sewage is allowed to rest motionless for a short time, the lime will settle to the bottom of the tank, leaving a colorless clarified fluid behind it. But if sufficient be not put in, and it is not properly mixed with the sewage, or the solution is made from hot fresh unslacked lime, then it becomes saturated with the fluid, and does little or nothing towards compelling the dirt to separate from the water of the sewage.

It can be easily found out when the lime is properly incorporated with the sewage by filling a clear glass vessel with the sewage from the point where it enters the tanks. The liquid will appear full of small globules or flakes similar to the air during a heavy fall of snow. If the fluid is allowed to quietly rest in the glass, it will be seen that the flakes settle down to the bottom, leaving a clear fluid, which, though beautifully clear, is strongly tainted by urine and lime, and if preserved in a bottle it will soon be seen to ferment and change color, proving that it needs filtering, and that lime should not be used to clarify sewage if that sewage is discharged unpurified into fresh water. The

The Chemical and Metallurgical Building, McGill University

sewage at Hamilton did not show the presence of the precipitant when I examined it.

We have gone into the details of Hamilton sewage works as we found them when we had the privilege of inspecting the plant and process, and have used the printed reports of the city engineer to get at the expenses, and so give our readers the facts in regard to the purification system that is held up as a pattern, though the cost per head of population for construction of the plant is over $2.25, and the annual cost of management, including interest on capital, shows at least 75 cents per head for clarifying less than half the daily run of sewage. Granting that the sewage is really efficiently clarified, if purification filters are built and the sewage after being clarified is purified, then the cost to the ratepayers will be almost twice the present amount; and should all the sewage be handled that flows to the works the cost may be increased by one-half again, so that a stiff bill will have to be paid by those who adopt this system.

In Europe many millions of dollars have been wasted in the erection of useless and inadequate works, many fine-looking plants have been built and operated to mislead and keep the people quiet, by pretending to do a work that they certainly were not doing, and glowing and misleading reports have been published about them. But careful inspection by the government officials has shown these works in their true light. All the defects and the reasons for these expensive failures in Europe have been published, and Canada can have the benefit of the Old Country's fifty years' experience and experiments for nothing. She can avoid the expensive works and pitfalls, and adopt systems that have cost large sums of money to discover. It is a remarkable fact that the systems so far adopted by Canadian towns are the ones that are the most expensive and the least efficient of a majority of the methods at present in use in Europe.

Jos. Walker, of Parry Sound, Ont., fireman on an engine on the C.A. & O.A. & P.S. Railway, was instantly killed in a rear end collision last month near Parry Sound.

The bill to incorporate the Nickel Steel Company of Canada, provides that the company, with the consent of the Governor-in-Council, may lease or purchase the following lines of railway: Bay of Quinte, Central Ontario and Irondale, Bancroft and Ottawa Railway.

McGILL UNIVERSITY.

McGill University is one of the world's great universities, not only because of the massive piles which shelter its lecture rooms and laboratories, and the great money value which they represent, but on account of the standing in the world of intellect of the men connected with it and the enthusiasm which they bring into their academic work. The university is a monument to the liberality and public spirit of a large group of Montreal's most distinguished citizens. The first of these was Hon. James McGill, who, dying in 1813, left the manor of Burnside to endow a university in which one college was to be called McGill. From this beginning the present flourishing institution has grown up, and the original endowment has grown by gifts from private individuals from one hundred and twenty thousand dollars to almost four millions of dollars.

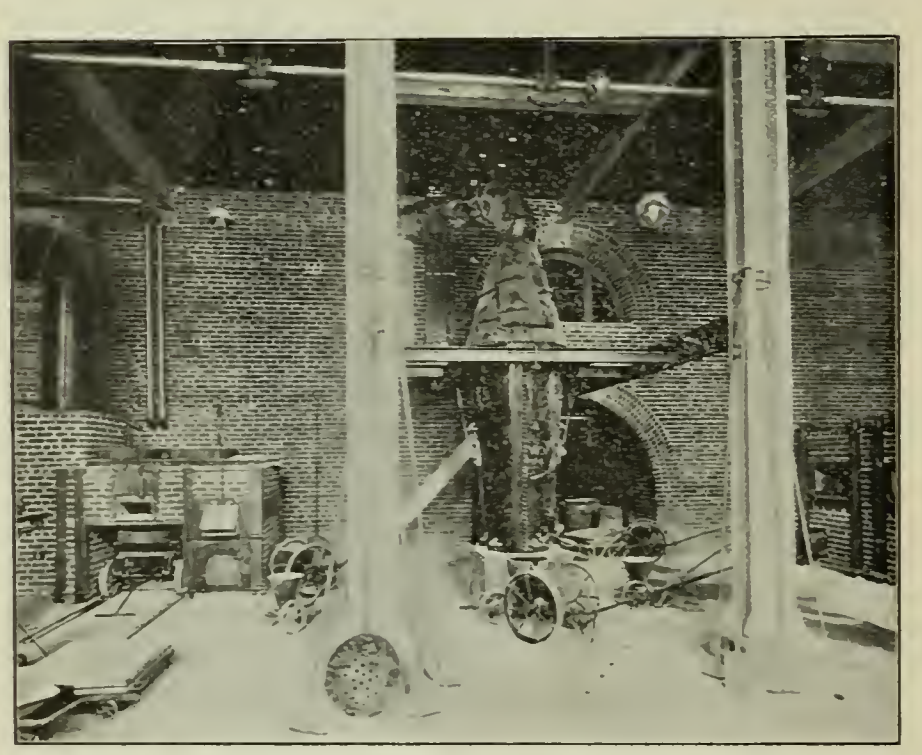
CHEMICAL AND METALLURGICAL DEPARTMENTS OF McGILL UNIVERSITY.

On the authority of Dr. W. C. Roberts-Austin, C.B., chemist of the British Mint, McGill University has now the best equipped metallurgical laboratory in the world. A similar remark might be applied to the mining department which has been in operation since March 1st. The mining department of McGill is splendidly housed in the McDonald Chemical and Mining Building, as shown in the accompanying engraving. The building is five stories in height, with basement and sub-basement. Extending from either side, at the back, are two large wings rising as high as the top of the ground floor. In these and in the rear part of the building are situated the principal rooms devoted to mining. There are the ore dressing room or mill, the smelting room, the metallurgical laboratory, the assay laboratory, wet assaying rooms and the teaching departments. These occupy a floor space of about thirteen thousand square feet.

The ore-dressing room has a twenty-foot ceiling and occupies the whole north wing. Here the ores of silver, copper, etc., and gold-bearing quartz in the condition in which they leave the mines, are received, and turned out metals in a form suitable for the furnace-room. The ores of gold, silver, copper, lead and iron are most important—but others can also be treated by this plant. It is full size

ASSAYING ROOM—MINING AND METALLURGICAL DEPT.—McGILL.

and differs from the ordinary mine equipment in that it is much more extensive. The usual commercial plant is designed as a matter of course to treat the ore of one mine, but the McGill appliances are sufficient to treat any kind of ore found in the Dominion of Canada. The student trained here will thus be at home with any first-class mining plant, and the plant at McGill being devoted to research and investigation only, unlike the average commercial plant, will be the means of producing many improvements in the methods of ore treatment now in vogue. The equipment consists of three rock crushers, known as "Blake," "Dodge" and "Comet" machines; two batteries of stamps, one of five five-hundred-pound



FURNACE ROOM—MINING AND METALLURGICAL DEPT.—McGILL.

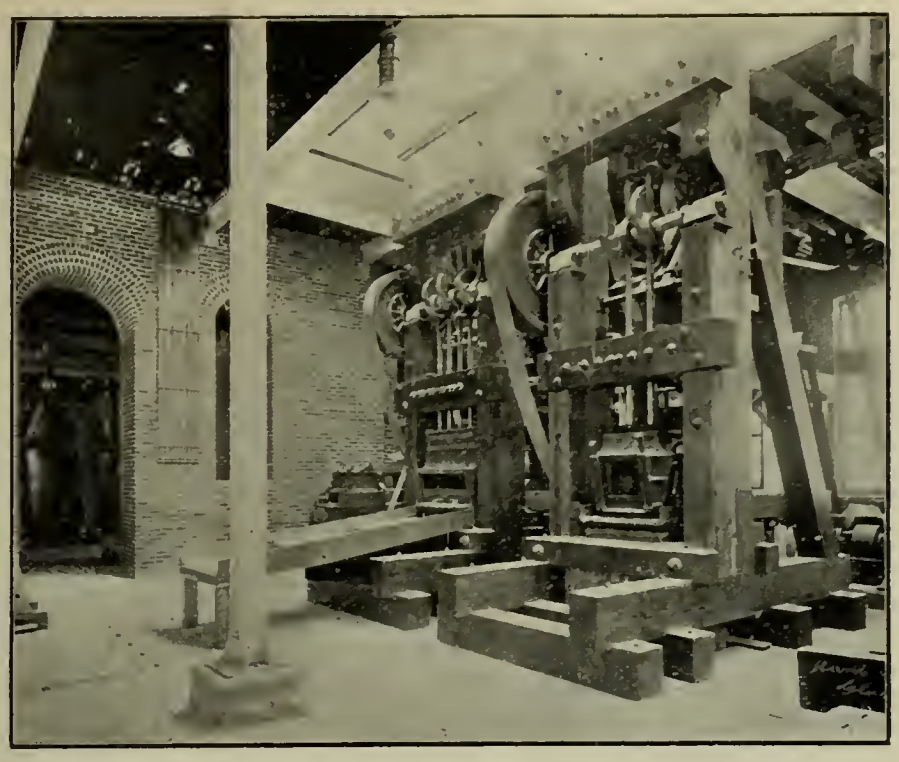
heads, the other of two of a thousand-pound heads each; a Huntington mill; coarse and fine crushing rolls; trowels and sieves; Hartz and Collum jigs, revolving, bumping and belt tables, and various pieces of apparatus such as magnetic separators, etc.

The crushers reduce the large fragments of rock to make easier the separation of the metal. The machines consist essentially of jaws moved by levers of great power. Into these the large pieces of ore fall, and are broken to a size convenient for the separating machines. The crushers are set in a high platform, the ore being carried up to them by means of a bucket elevator. The broken-up product of the crushers drops down, and is received in trucks which are capable of being rolled along the floor, or being hoisted up and moved about by the overhead system of travellers. According to its kind, the ore on leaving the crushers is carried to the stamp batteries or to the Huntington mill. Into either of these machines it is fed by an ore-feeder. In the stamp batteries the ore is pounded by swift blows from heavy hammers until it becomes a powder. Then, if it is gold ore, the mixed powder of gold and rock is passed into a quantity of mercury in a pan. The gold forms an amalgam with the mercury, and is held while the valueless rock is taken out. The heavy blows of the stamp battery are borne by a huge block weighing many tons, which extends deep into the earth. The Huntington mill accomplishes the breaking up of the ore in another manner, The ore being fed in falls into a heavy, tub-like receptacle, in which are four heavy iron disks attached to a shaft, in the centre, which revolves rapidly. The disks are so attached that they are free to move toward or away from the centre within the limits of the tub, but centrifugal force caused by the revolution of the shafts keeps them against the sides of the tub, and they revolve as they move thus in a circle. The ore is thus moved about inside, and is ground up into small fragments.

The methods of separating the ore from the rock involve a number of interesting machines. The Frue Vanner is one of these. It consists of a wide continuous sheet of rubber, with turned-up edges, stretched upon two revolving cylinders. One cylinder is lower than the other, so that the plane of the rubber sheet is inclined slightly. The broken mixture of metal and rock is fed upon the central part of the incline, and moves up (the sheet moving in that direction), until it encounters a spray of water which impinges on the sheet and carries down with it the rock. The metal being of greater specific gravity, holds its place on the sheet in spite of the water, and is carried until automatically washed off into a basin prepared for it. The jig separator is fed from three large hoppers connected to a revolving screen immediately above it. Through all its compartments water flows continually, and the ore is separated and sorted into the several qualities according to its specific gravity and size. The amalgamator and settler are rather complicated instruments, which extract gold from the slime resulting from previous separating processes.

As a preparatory process to treatment on the Rittenger table or Evans Buddle the pointed box may be used. This is a series of boxes or basins of conical shape, and varying in size. The sand from the stamp battery is fed

first into the smallest box, through which a stream of water is flowing so swiftly that only the largest grains are allowed to sink. The remainder is carried into the next larger box or basin, where the water spreading out has a less velocity, and the next size of grain is deposited, and so on.



Stamps—Mining and Metallurgical Dept.—McGill.

The Evans table serves to concentrate slimes and fine sediments on a circular bottom. It is a large round table sloping from the centre. As the table revolves the slime is fed upon it at the centre and flows toward the circumference, leaving in its progress the heavier portions of its constituents, while the surface is continually swept smooth by means of revolving brushes. Thus the particles of different densities are arranged in concentric circles, and can be carried by properly directed jets of water each into its proper receptacle.

The Rittenger table is a huge inclined plane of plate glass, which is jerked abruptly from side to side and mixed pieces of ore are sorted as they travel down its inclined surface, water flowing along with them. The repeated jerks cause the heavier pieces to travel steadily away from the lighter, and eventually the two come off the table at opposite corners. A good deal of the ore reduction machinery is supplied by Fraser & Chalmers, Chicago.

Adjoining the ore-dressing room is a second very large room used as the smelting room. Here the ores will be

Balance Room—Mining and Metallurgical Dept.—McGill.

roasted or smelted, which ever is necessary. The room will contain an English cupellation furnace, a reverberating roasting furnace, a Bruckner cylinder and a twenty-inch water-jacket furnace, as well as two-pot furnaces, each eighteen inches in diameter. Part is the tool room, and alongside is a small motor to run the machines in the immediate vicinity. The lowest floor of the south wing is taken up by the assaying rooms. In the dry assaying room are fourteen assaying furnaces of the best and latest pattern. Opening from it is the balance room. The apparatus of this room is of the sort commonly used in chemical laboratories, and the rooms themselves are nicely finished with white and buff-colored enamelled brick.

The portion of the building devoted to teaching, and designing and drawing rooms, is admirably arranged. The lecture room is fitted with numerous appliances for demonstrating the subjects taught, including an electric lantern for illustrations. Adjoining this is the office of Dr. Porter and his private research laboratory.

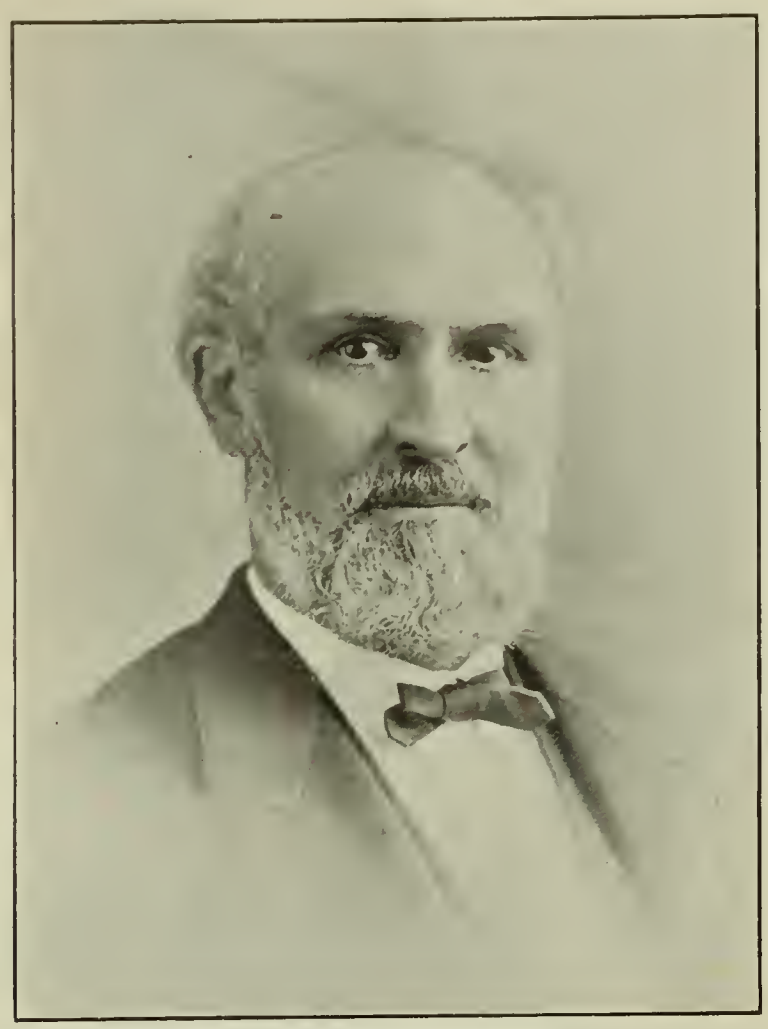
The portion of the building occupied by the chemical department is spacious and well equipped, and the ground floor and first basement floor are lecture theatres constructed on the latest plans. Throughout the buildings are lofty ceilings, ample lighting and modern appliances for ventilating and guarding against fires. On each of the three floors above the ground floor, extending all across the back of the building, is a large room—each of which is fitted up as a chemical laboratory, with every convenience and appliance which has been suggested by the experience of all the largest chemistry schools in the world. In addition to an unusual accommodation in

A Lecture Room—Mining and Metallurgical Dept.—McGill.

the line of draught cupboards for the carrying off of unpleasant or poisonous gases, there is a system of large flues in every part of the building connected to large ventilating fans in the roof. A noticeable convenience is a store-room on each floor adjoining the elevator. On the first floor in front are the offices of Prof. Harrington and his assistants and a commodious library and reading-room.

Among the many citizens of Montreal who have given largely for the provision of educational facilities in that city, none has been more generous in giving, nor has any one made wiser disposition of his gifts, than W. C. McDonald, whose endowments of McGill University now amount in buildings and funds to almost two millions of dollars, being more than has been given by any other Canadian to any educational cause.

Mr. McDonald is the youngest son of the late Hon. Donald McDonald, some time President of the Legislative Council of Prince Edward Island, and is grandson of Capt. John McDonald, 8th chief of the Clan Macdonald of Glenaladale, who after founding the Scotch settlements at Tracadie, Scotchfort, Glenfinnin and Fort Augustus, P.E.I., served during the American Revolutionary War as a



W. C. McDONALD.

captain in the 84th or Royal Highland Emigrant Regiment. He was born at Glenaladale, Tracadie, P.E.I., 1833, and was educated at the Central Academy, Charlottetown, also obtaining his business training in that city, under the late Hon. Daniel Brennan. He left P.E.I in 1854, and removing to Montreal became an importer and general commission merchant there. Subsequently, he embarked in business as a tobacco merchant and manufacturer, and now owns the largest tobacco factory in Canada. He is a governor of McGill University, a governor of the Montreal General Hospital, and a director of, as well as the largest shareholder in, the Bank of Montreal. He is an honorary member of the Architects' Association of Quebec. Among his gifts to McGill are : $20,000 to the Thomas Workman endowments for mechanical engineering; the erection and equipment of the W. C. McDonald engineering building, valued at $350,000, and an endowment for its maintenance ; the endowment of the chair of Electrical Engineering with the sum of $40,000 ; the erection and equipment of the Physics building, valued at $300,000, and two chairs of Physics, with endowments amounting to $90,000; the endowment of the Faculty of Law with $150,000; a further sum of $150,000 for the maintenance of the engineering building ; $50,000 towards the endowment of the Pension Fund, and the erection of a new building for the department of chemistry, mining and architecture, at a cost of $500,000.

The Goldie & McCulloch Co., of Galt, Ont., have shipped a big Wheelock engine to the Montreal Belt Line Railway Company. The engine weighed 19,440 pounds.

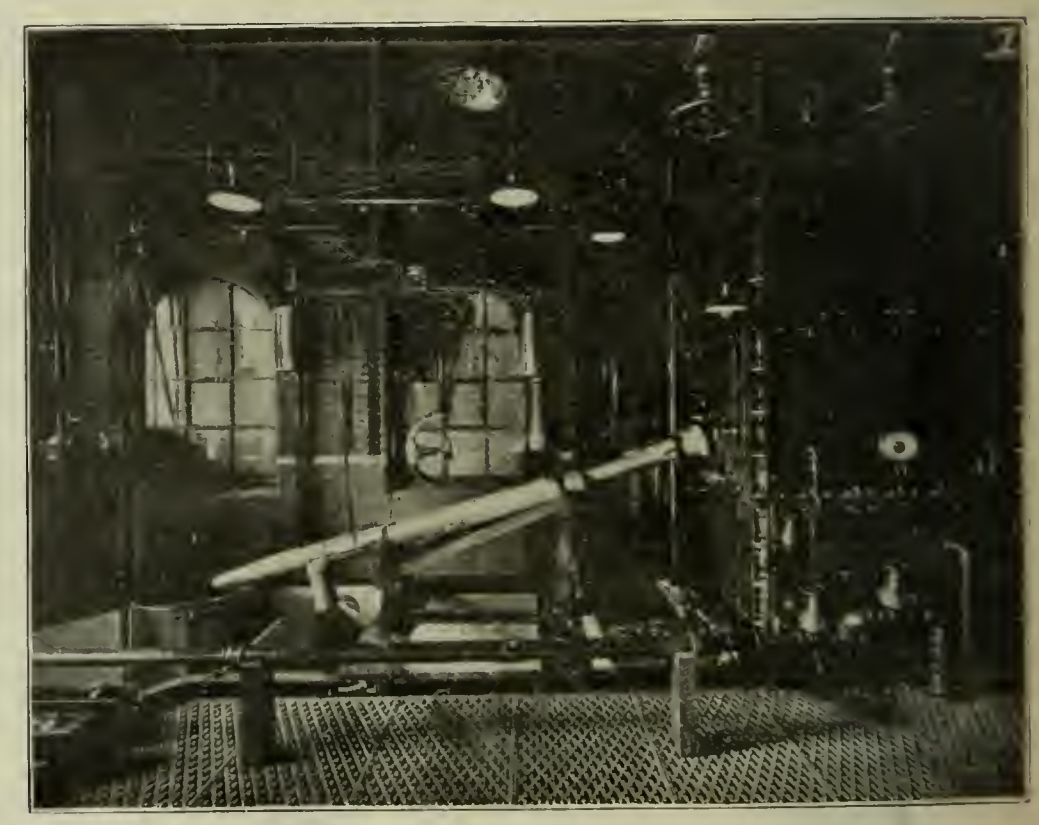
The Montreal and Southern Counties Railway Company, which obtained its charter last year, has been given power to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville, and bonding powers increased from $20,000 to $25,000 a mile, in addition to preference stock, $10,000 a mile. There are extensive powers for connecting with other railway companies or crossing the St. Lawrence, and for amalgamating with other companies, but the company is debarred from running along the streets of Montreal or adjoining municipalities. Powers are also given to run steamers, maintain pleasure grounds, and sell electricity for light, heat or power.

HYDRAULIC LABORATORY, M'GILL UNIVERSITY.*

BY HENRY T. BOVEY, M. INST. C.E., LL.D., ETC., AND J. T. FARMER, MA E.

The laboratory is 39 feet in length and 31 feet in width. On the north side, near the centre, stands the experimental tank, having its base on a level with the bottom of a flume. The flume, which is 5 feet wide and 3 feet 6 inches deep, runs from the tank and terminates in an adjustable weir. The water flowing through the flume may pass over or under the weir and may run to waste or may be made to pass into five large carefully calibrated tanks, 8 inches below the floor level and ranged in series on the south side of the laboratory. The covering of the tanks is on the level and forms part of the floor. Over the easternmost of the tanks stand the experimental pump on a base formed of suitably designed carrying girders or trunks. The section pipes descend into the tank and thus allow the water passing.

On the west side, at convenient points along the flume, are the following pieces of apparatus: A 16-inch Pelton wheel, with brake attachments, a turbine tester of special design and an experimental centrifugal pump. Along the west wall is fitted up a Rife hydraulic ram with all the necessary pipes and tanks for experimental work. The pumps are driven from a line of 3½-inch steel shafting near and running parallel with the east side of the laboratory. The shafting is operated by a 100 h.p. Mackintosh & Seymour high-speed horizontal engine, standing in an adjoining room. By means of an electro magnetic coupling, designed by Prof. Carus-Wilson, and connected with a switch conveniently placed near the experimental pump, the main shaft can be almost instantaneously thrown in and out of gear, and without sudden impact or shock, as the circular armature permits a partial rotation until the resistance is overcome. A 90 h.p. automatic recording transmission dynamometer is placed on the shaft between the magnetic coupling and the nearest point at which power is transmitted. An 8-inch line of piping makes a complete circuit of the laboratory near the ceiling. The several pumps and motors are connected with this circuit, and the movement of the water is controlled by suitably placed 8-inch straightway valves, branch tees, elbows, etc. By means of a short vertical length of 8-inch piping,



terminating in a goose-neck, the pumps can be made to discharge into the top of the experimental tank, from which the water passes into the flume, then into the large tanks, and is thus again available for supply The whole of the water used in the laboratory is drawn from the city high level reservoir, which gives at the base of the tank a pressure of more than 120 lbs. per square inch. The city service is connected with the 8-inch circuit, which can therefore, if desired, be made to act as a supply pipe to the turbines and other motors. Provision is also made for connecting the latter directly with the city service. The pumps and motors all discharge into the flume, and the water then passes over the weir where the volume of discharge can be measured. If the volume is not too great, it can be at once measured by passing the water into the large calibrated tanks.

The weir may be used the whole width of the flume without side contractions, but by means of suitable checks one or more side contractions can be introduced and the width of the weir diminished to any required extent, or the weir may be subdivided into two or more independent weirs. A large number of experiments have already been made to determine the co-efficient of discharge with and without side

*Extracted from a paper read before the Canadian Society of Civil Engineers.

contractions, and with different depths of water over the weir lip. The results will be given as soon as the experiments have been completed. The water may be conveyed to any one of the five tanks through an iron channel provided with properly placed manholes, and the five tanks can all be connected together by means of a 10-inch pipe running along the bottom of a deep trough next the wall, and having the

necessary valves and 6-inch branches communicating with the several tanks. The water may also be run to waste through this 10-inch pipe. In this channel and next the weir there is a flap-door with edges inclined at 45° to the vertical. The edges of the gap closed by the door are also inclined at 45° to the vertical, and the fit between the door and gap has been made as perfect as practicable. An india rubber cord is inserted in an endless groove running along the centre line of the edges, so that when the door is closed and pressed home it is absolutely water-tight. The door can be instantaneously opened and closed by means of a lever and a system of links acting as a toggle-joint, and each movement is recorded by an electrical chronograph. In any given experiment the door is opened and the water allowed to run to waste until the head over the weir lip is steady, when at a signal the door is instantaneously closed, when the water is conveyed by the channel into any or all of the tanks.

The stand-pipe for the fire-hose rises vertically at the back of the tank and extends to the full height of the building. At the base it is provided with a number of unions varying in size from six to one inch, and to these unions are attached the lines of piping for pipe-flow experiments. The position of the stand-pipe was selected so as to allow of straight lengths of more than 400 feet of pipe being used. To secure a uniform pressure a Locke Regulator has been provided, which responds, though slowly, to a variation in the pressure. A special piece of apparatus for hose testing has been placed in the south-west corner of the laboratory. It is connected by hydraulic piping with the Blake pressure pumps in the testing laboratory. A large number of tests have been made on the strength, and on the longitudinal and circumferential extensibility of different varieties of hose, which in the great majority of cases was in lengths of 50 feet. The pressure, which often exceeded 800 lbs. per square inch, was directly indicated by a standard Crosby gauge, while the time and pressure were also registered automatically by a recording gauge specially designed for this work.

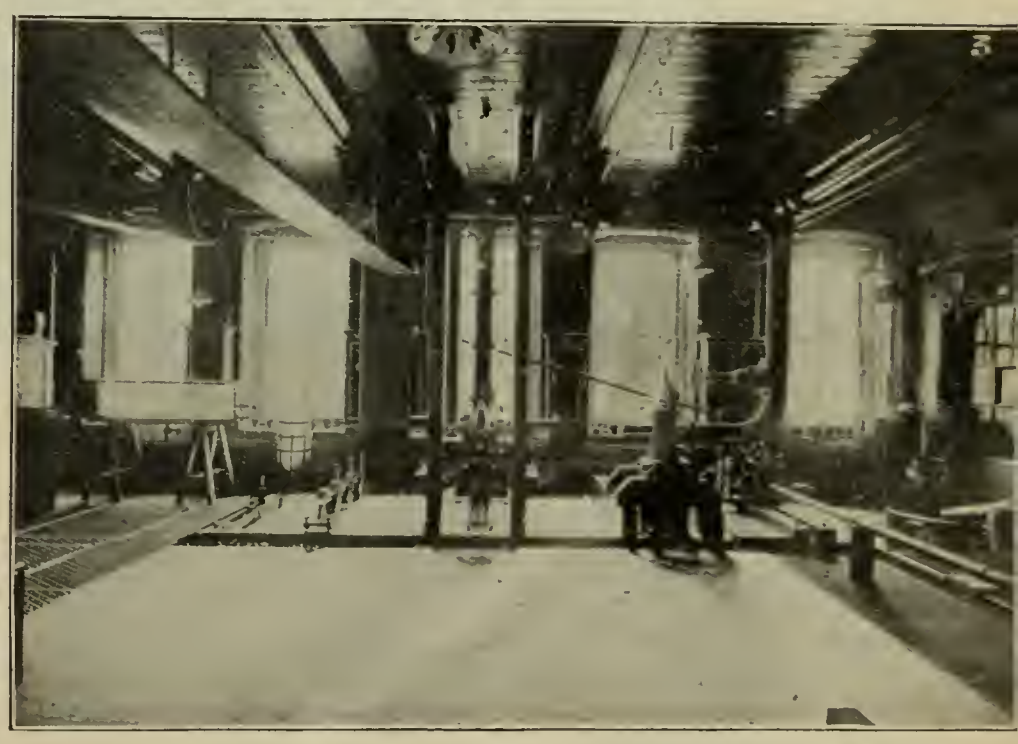
Of the remaining apparatus the following may be briefly noticed :—

A glass tank, 72 inches by 18 inches by 12 inches, with circular diaphragm chamber at one end. This serves to illustrate vortex ring motion, and also, with the aid of glass tubes with flared ends and of different diameters, the critical velocity and other stream-line phenomena. Inverted glass domes, with an orifice in the bottom, with which are demonstrated the phenomena of circular and spiral vortex motion, of the inversion of the vein, etc. A series of very carefutly made nozzles with a perfectly smooth bore, and having pressure gauge attachments at each end. Each nozzle is 36 inches in length between the gauge connections, and has a taper corresponding to a diameter, varying from 3 inches to 2¾ inches in the largest to 3 inches to ½ inch in the smallest. A series of sixty hydrostatic gauges, each with a range of 20 lbs. and embracing pressures up to 140 lbs. per square inch. The gauges are graduated to tenths of a pound, and the range of every gauge is overlapped by the two consecutive gauges. A mercury column 27 feet in height, is fixed to the north wall near the experimental tank, and in addition to this there are several small portable mercury columns, which are used in the experiments for determining the resistance to flow in small pipes due to elbows, bends, convolutions, etc. These pipes are 13 in number, have a smooth bore and are ⅜ inch in diameter. The laboratory is also supplied with a Venturi and other piston and rotary meters, a number of hook gauges, Darcy's improved Pitot tube, brass standard gallon, quart and litre measures with glass strikes, etc , etc.

There are several copper measures of capacities varying from 10 to 100 gallons. They have been carefully calibrated, and the calibrations are frequently checked. When in use they are placed upon a plane-table with adjustable feet so that a true level can be always maintained. Each of the large tanks already referred to is 6 feet by 3 feet 6 inches by 9 feet deep, and discharges into the 10-inch header through a 6-inch straightway valve. Each tank is also connected with a separate vertical 4-inch brass pipe, in which the water freely rises and falls with the water in the tank. This forms the float chamber. These tanks have been carefully calibrated, and the contents can be readily measured to within the sixteenth of a gallon. The float is attached to a vertical $\frac{3}{8}$-inch brass rod with a pointer at the upper end, indicating on a brass plate the quantity of water in a tank. A fine cord, fastened to the top of the rod, rises vertically, passes around a frictionless pulley, and carries a constant weight at the end which counter-balances the rod, etc., keeps the cord taut, and so prevents the pointer from rubbing against the plate.

The experimental tank is of cast iron, is 28 feet in height, square in section, and has a sectional area of 25 square feet. Every care was taken to make the inside surfaces of the tank walls perfectly flush, and to this end the flanges, by which the several sections were bolted together, were placed on the outside.

The impact apparatus was constructed for the purpose of determining the force with which jets from orifices, nozzles, etc., impinge upon veins of different forms and sizes. A massive cast-iron bracket, 8 feet in length, has one end securely bolted to the front of the tank, and the other supported by a vertical tie-rod from one of the oak beams in the ceiling. The upper surface is provided with accurately planed slides, which are set level about 5 feet above the orifice axis. If, from any cause, the end of the bracket farthest from the tank is found to be too high or too low, the error can be corrected by loosening or tightening the nut on the tie-rod. The balance proper is carried by a sliding frame, which can be moved horizontally into any position along the bracket by means of a rack and pinion actuated by a sprocket wheel with chain. At one end the frame has two equal arms with a common horizontal axis parallel to the bracket, and each arm has a stop on its lower surface which serves to limit the oscillation of the balance. The balance, in its mean position, consists of a main trunk



with horizontal axis rigidly connected with a vertical slotted arm and with two equal horizontal arms at one end. The common axis of the latter is horizontal and perpendicular to the axis of the main trunk. The hardened steel knife edges of the balance are 4 feet centre to centre, and rest in hardened steel Vees inserted in the ends of the sliding frame on each side of the bracket. The bottom of each Vee is in the same horizontal line (called the axis of the Vees) at right angles to the bracket. A bar with the upper portion graduated in inches and tenths has a slot in the lower portion, which is bent into a circular segment of 9½ inches radius The bar slides along the slot in the vertical arm of the balance. A radial block, with the holder into which the several vanes are screwed, moves along the slot in the circular segment, and may be clamped in any required position, the angular deviations from the vertical being shown by graduations on the segment. The centre of this segment in every case coincides with the central

point of impact on a vane, is in the vertical axis of the balance arm, and is also vertically below the axis of the Vees. Thus the jet can always be made to strike the vane both centrally and normally. The scale pan hangs from a knife-edge at one end of the horizontal arms of the balance, while to the other end is attached a fine pointer, which indicates the angular movement of the balance on a graduated arc fixed

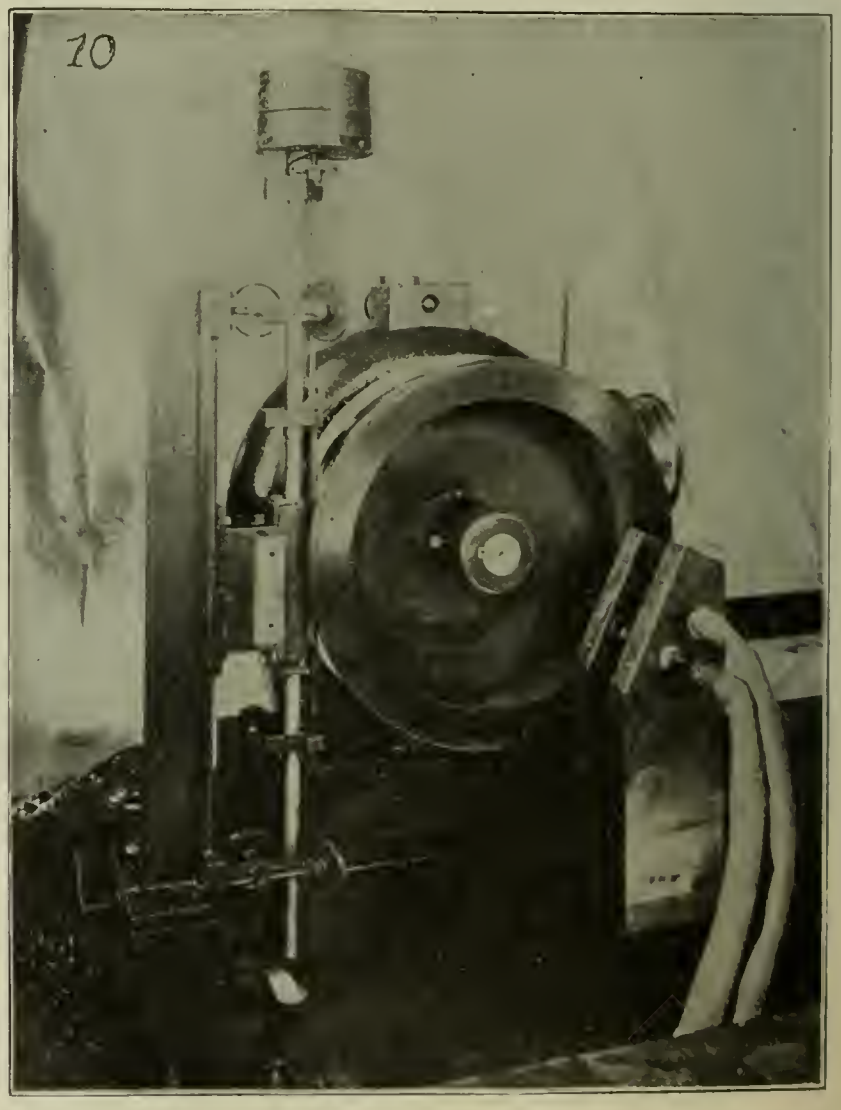
to the sliding frame. The balance is in its mid-position when the pointer is opposite the zero mark. When a vane has been secured in any given position, the preliminary adjustment of the balance is effected by moving a heavy cast-iron disc along a horizontal screw fixed into the main trunk. The sensitiveness of the balance is also increased or diminished by raising or lowering heavy weights on two vertical screws in the top of the trunk.

In motor testing it is often of importance to know the pressure of the water at certain points in the supply (or delivery) pipe, and, generally speaking, it is impracticable to employ either a mercury or a water gauge. The pressure is therefore observed by standard Bourdon gauges, of small individual range, which are frequently tested, a record being made of the errors. The method usually adopted to diminish the oscillating effect of the gauge of the fluctuation in the flow is to connect the bore of the pipe with an annular chamber by a number of small holes. In the McGill Laboratory these holes have been replaced by a continuous opening around the bore, less then .005 inch in width, with the obvious result of obtaining a better mean pressure. Similar chambers are also being used in experiments on the resistance of bends to flow. There are four sets of bends of 1 inch, 1½ inch, 2-inch and 3-inch diameter, and each set consists of 30 bends, 10 having a radius of one diameter, 10 of two diameters and 10 of four diameters. At the central cross-section of each bend, provision is also made for ascertaining the pressure, either by a mercury column or by a gauge, at the extremities of the radii to the outer and inner surfaces of the bore. The chambers for the bends are combined with union couplings, of the same bore, which allow the attached part to be swivelled through any required angle.

The speed of the motor is taken by a revolution counter and also by a tachometer. A sliding slotted sleeve at one end of main shaft of the motor can be made to engage with the spindle of the revolution counter, which can therefore be readily thrown in and out of gear at the commencement and end of a test, and the readings can be taken at leisure. The tachometer is supported on a bracket fixed to the motor frame, and is driven by a cord passing over a pulley on the motor shaft.

Besides a Halpin brake of 50 h.p. capacity, the laboratory is equipped with a friction brake which has been designed by Mr. Withycombe, the superintendent, and which can be used with wheels both of the horizontal and the vertical type It possesses many novel features of which the most important are :—That it is self-adjusting, and that a single direct weighing gives the total drag. The brake wheel is of cast-iron and finished on a lathe. The outer and inner surfaces of the rim are shrouded, the shrouding on one side being formed by the solid disc connecting the rim with the boss. A stream of water is delivered tangentially into the channel inside the wheel through a narrow rectangular mouthpiece of nearly the same width as the channel. The surplus water is carried away by a scoop of somewhat similar form but reverse in action. The tight portion of the brake band is of leather, and the slack portion consists of two strips of copper. In the mean position, each portion embraces about one-half of the circumference of the pulley, and its end is attached to a lug projecting from a rod. The lug to which the slack portion is joined is capable of sliding along the rod, and by means of a screw, can be adjusted so as to increase the slack tension as desired, and therefore to produce any required total drag. The rod in the direction of its length has a practically frictionless range of five inches, which corresponds to a variation of about 16° in the angle of band contact. The resultant force along the rod is the difference between the tight and slack tensions, and measures the drag. The force is balanced by dead weights which are placed in a tray at the top of the rod for a vertical wheel, and if the wheel is horizontal, in a scale-pan suspended by a cord which passes over a frictionless pulley and is attached to the head on the rod.

If from some cause, the band friction should increase, the drag would also increase, and there would be a corresponding movement of the rod. Thus a portion of the leather band would be unwrapped, while an equal portion of the copper band would be brought into contact. But the frictional co-efficient for leather exceeds that for copper, so that the drag would be less and would continue to diminish until it again balanced the weight. The reverse, of course, would be true, if the band-friction should diminish. The rod would move in the opposite direction, an excess of the leather band would be brought into contact and the drag would continually increase until equilibrium was again restored. Hence, within a certain range, the band will find a position of equilibrium, although the friction may vary, and the total drag will then be measured by the dead weight in the tray or in the scale-pan. If the movement of the rod should be so great that it may come against one of the stops provided to limit its action, the drag can be readjusted by means of the screw attachment. This, however,



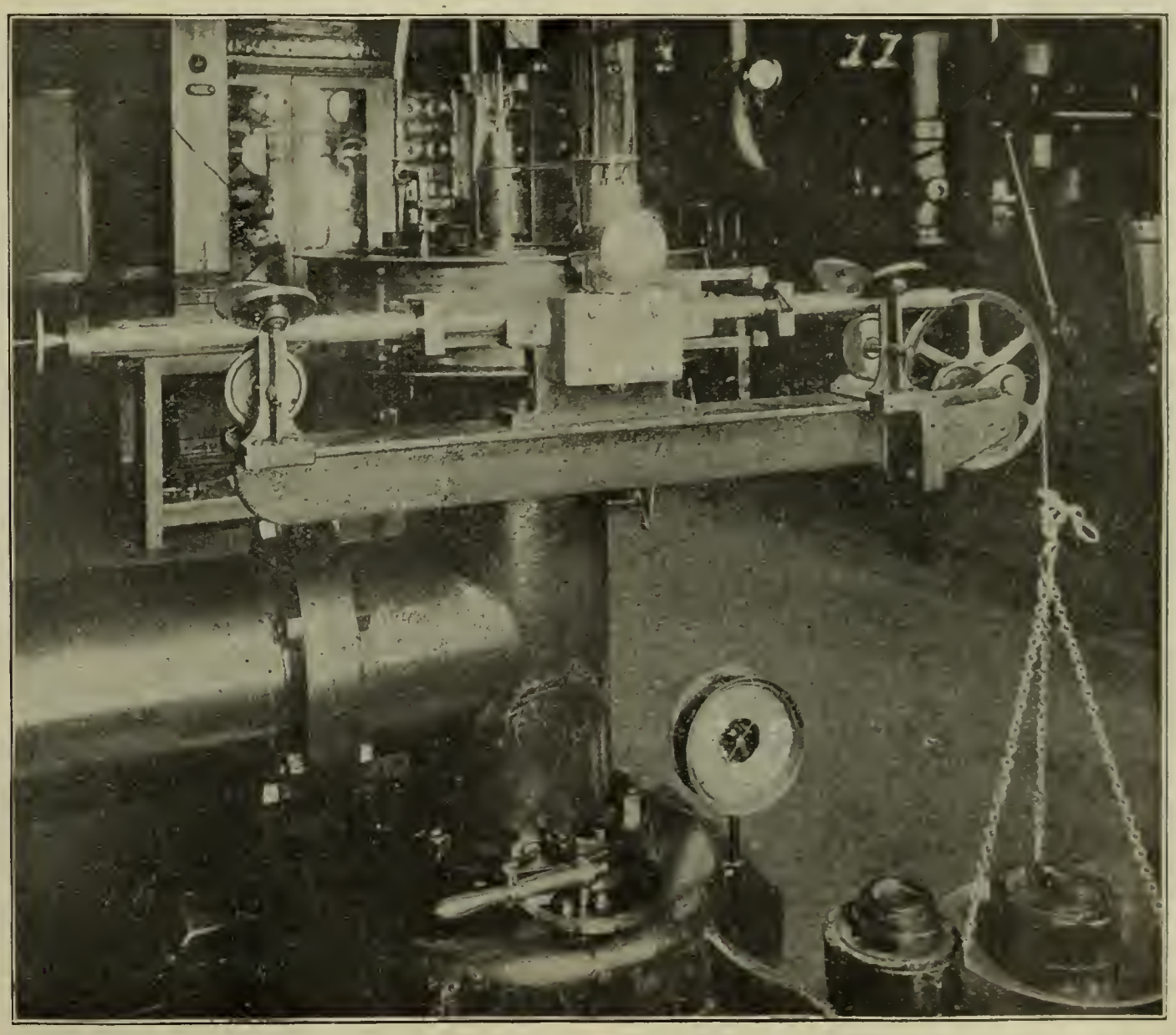
is very unlikely to happen, as the range already allowed is sufficient to admit of a large variation in the value of the co-efficient of friction. It has been found that the best results are obtained by running the wheel without any lubricant on the rim ; care should be taken to protect the rim from water or oil, which would necessarily produce a considerable variation in the frictional resistance. This brake has been in use only a few months, but in the several trials which have been made it has fully realized the expectations that had been formed of its efficiency. It has been employed in measuring directly off the jack shaft the power developed by a 6-inch turbine with vertical axis and a 16-inch Pelton wheel with horizontal axis.

The whole of the water is discharged into the flume, and passes over the weir into the large calibrated tanks. If the quantity is too great to be measured in the tanks, the water is run to waste and the discharge calculated from the normal weir formula. Co-efficients of discharge have been found for various depths over the lip, and the co-efficient for any particular depth can be very approximately determined by interpolation. The depth over the lip is obtained by means of the "depthing" apparatus, which consists of a deep girder stretching across the flume and carrying three hook gauges with Verniers which read to .001 inch.

The centrifugal pump is erected over the flume in a framework which allows it to be raised or lowered so that the heights of suction and discharge may be varied at will. For this purpose the piping is made in interchangeable lengths of 2 feet. The pump is driven by a 9-inch belt and discharges into the ceiling circuit already described. From this circuit the water is delivered into the top of the experimental tank, flows into the adjoining flume, passes over an intercepting weir for calibration and is then again conveyed along the flume to the pump. Thus, the same water can be used over and over again.

approximate maximum delivery is estimated to be 1,000 gallons per minute when the pump is running at a speed of 150 revolutions per minute against a pressure of 120 lbs per square inch. The suction valve chambers are placed directly over the calibrating tank nearest the east wall, and draw the water from this tank through two 10-inch suction pipes. Each discharge valve chamber is directly connected with a 12-inch header, which discharges into the 8-inch ceiling circuit. The water may be made to flow in almost a direct line to the point of discharge, or it may be made to pass around the three sides of a rectangle so that the effect of the additional bends and increased length of piping may be estimated. The water flows into the experimental tank at a point 20 feet above the level of the discharge valves.

One of the features of the pump is the provision made that the valves can be taken out and replaced by others of a different type. The valves at present in situ are a Riedler valve and two with groups of 36 circular disc valves of $1\frac{5}{8}$ inches diameter in each. In addition to the usual pressure gauges, tachometer and revolution counter, the pump is fitted with a specially designed continuous triple indicator apparatus, which autographically records during any given time of a trial the



The turbine is supported upon an angular flange bolted to the bottom of a cast-iron cylinder. An 8-inch tee is secured to the crown of the cylinder, and a cover with a specially designed gland is bolted to the upper flange of the tee. The jack-shaft passes through this gland, which forms an almost frictional bearing. No packing is required, as provision has been made for carrying away any slight leakage that might occur. The jack-shaft passes through a piece of pipe screwed to the bottom of the cover and extending downwards to the cylinder, so that it is protected from the impulsive effect of the inflowing water. The supply pipe is connected with the horizontal branch of the tee, and the entrance of the water is controlled by an 8-inch straight-away valve placed at some distance from the opening. The gates of the turbine, for example, one of the New American inward and downward flow type, are worked by means of a shaft extending from a pinion geared to the toothed quadrant and passing through a gland in the crown of the cylinder. The upper end of the shaft is provided with a handle and pointer, which indicates on a graduated quadrant the extent of the gate opening. Suitable pressure gauge connections have been arranged in the upper and lower parts of the cylinder. The power of the turbine is determined by the friction brake already described.

The experimental pump is of the vertical triple-throw single acting plunger type, and is driven by two 10-inch double leather belts running on 48-inch pulleys formed on the outer crank throws, or discs. The plungers are 7 inches in diameter and have an 18-inch stroke. The speed, variation and duration of the valve chamber pressure at any point of the stroke. Sight holes are provided for observing the movement of the valves and indicators for recording their lift. A special recording gauge also registers the pressure in the delivery pipe. As the pump is for experimental work, it has been made unusually heavy, its total weight being about 55,000 lbs. The plungers, valves and valve seats, all internal screws, nuts, etc., are of bronze, and weigh more than 3,700 lbs.

TORONTO AND SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER:

SIR,—On March 17th, Jno. McDougall, of the Detroit Purification Company, who pushes the old system of the International Water and Sewage Purification Company, of London, England—which company has within the last two years improved its methods by making its filtering process into an intermittent, in place of a continuous flow system, thereby purifying the sewage by bacteria which require atmospheric air regularly at short periods—appeared before a special committee of the Toronto City Council and described the method of treatment, and also showed blue print drawings of the precipitating tanks and filters that they adopted. The plan of the tanks and full information we have before published in the October and November issues of 1896, and the March and May issues of 1897.

Mr. McDougall's remarks showed that his company keeps to the old methods of continuous flow both in the settling tanks and filters, while

his principals in England have been compelled by the sanitary inspectors to march with the times and adopt the intermediate system. This system is about the most expensive one that can be adopted, and includes some intricate sludge machinery that soon gets out of order and is really unnecessary because the sludge will come away better without it. The ferrozone precipitant necessary to this system would be a heavy, constant and useless expense. The polarite used for the filtrate is said to cost $30 per ton, and it is now a recognized fact that screenings of coal that only cost $2 50 per ton, are far more efficient and lasting when used as a filtrate, standing ahead of every other material except charcoal made from wood or towns' garbage. On page 326 of the March, 1897, issue of THE CANADIAN ENGINEER, there is a table showing the cost of sewage disposal in twenty towns of England. The last one, Swinton, is worked on Mr. McDougall's plan. Of this town, Mr. McDougall's company states that there is 16,000 population, the average daily sewage is 300,000 gallons, that they can give their sludge away, that their tank capacity is 240,000 gallons, that the plant cost $30,000; it costs $3,000 each year to manage it and pay for ferrozone. The population of Toronto is over twelve times that of Swinton, and Dr. Sheard said that there will be a much larger quantity of sewage per head discharged in Toronto than in British towns. In that case our sewage works may cost about $360,000 for plant, and $36,000 per year after, and then we might have to provide sludge presses and furnaces to burn the sludge cakes in addition.

Mr. McDougall was ably supported in showing the advantages of his company's system by Mr. Warner, who had come all the way from Nottingham, England. He is the patentee of the Low Temperature, Slow Burning and Natural Draught Garbage Destructor, which has been fully described in page 286 of the last February issue of THE CANADIAN ENGINEER. When answering a straight question put by Ald. Lamb, Mr. Warner stated that the Toronto garbage destructors were similar to the ones he built twenty years ago, and it will be admitted that the high temperature fume consuming, quick burning and heat raising destructors are five years ahead of the low temperature ones, so that Toronto must be a quarter of a century behind similar towns in this line of sanitary appliances. The saying of the late Benjamin Franklin, viz., "Be careful that you do not pay too much for your whistle," is applicable when a sewage scheme is under construction.

EXPERT.

Toronto, May 15th.

CEMENT IN ONTARIO.

During 1897 the cement industry in Ontario has made satisfactory progress, as shown in the report of the Bureau of Mines. Both the natural rock and Portland cements are showing a large increase of production, and manufacturers are establishing a good reputation for the qualities of the cements they are putting on the market. The increase, however, is not shown in the number of establishments, which are two less now than four years ago; but in number of men employed and amount of wages paid for labor, in quantity of cements produced and in their value there is a gratifying evidence of progress. The number of men employed in these four years has increased from 168 to 231, the wages paid for labor from $44,878 to $89,060, the quantity of cement manufactured from 85,903 barrels to 181,495 barrels, and the value of the cement from $109,834 to $246,425. The greatest increase, however has taken place in the production of Portland cement, which has gone up from 30,580 barrels to 96,825, while the natural rock cement has only increased from 55,323 barrels to 84,670. In value natural rock cement shows an increase of $27,349, while the Portland cement shows an increase of $109,242. This, no doubt, is largely, if not chiefly, owing to the growing interest in the building of good roads in our towns and cities.

All of the natural rock or hydraulic cement works are now situated along the Niagara escarpment, extending from Queenston, near the Niagara River, to Limehouse, on the main line of the Grand Trunk Railway.

One of the Portland cement works is situated at Shallow Lake in Grey county, where the business is carried on by the Owen Sound Portland Cement Company. New machinery was added during the past year, and new buildings and more kilns are now in course of erection which, when completed early this summer, will bring the output up to over 300 barrels per day. The product of the works is known as the Samson brand, and the manager states that not a single complaint was received last year regarding the quality of the material put upon the market. Both the marl and the clay used in the manufacture of cement at these works are obtained from the bed of Shallow Lake.

The works of the Rathbun Company at Napanee Mills were also enlarged last year, and they have now an estimated capacity of about 350 barrels per day. The plant embraces the latest and best developments in Portland cement making, and is constructed with a view to produce material of very uniform quality. The clay and marl are mixed in proportions carefully regulated by chemical analysis, and the slurry is so finely reduced in the mixing mills that it will all pass through a seive of 100-mesh, or 10,000 holes per square inch. Two new burning kilns were erected last year, making three in all; they are of the continuous type, and produce a very uniform well burnt clinker. In the grinding mill the clinkers are ground to an extremely fine powder, and, so finished, it is conveyed to bins in a new storehouse, which has a capacity of 50,000 barrels. The Rathbun Company's cement is known as the Star brand, but they are now producing a quality called the Silica Portland. The marl for the works is drawn from an extensive deposit on the line of the Bay of Quinte Railway, and the clay from a property adjoining the works.

During the fiscal year ending June 30th, 1897, Canada imported 210,871 barrels of Portland cement, valued in the Trade Returns at $252,587; so there is yet considerable room for expansion in the industry at home.

PNEUMATIC GRAIN-HANDLING MACHINERY.*

BY FREDERIC ELIOT DUCKHAM.

The grain trade of the world has been steadily increasing, and the bulk of the cargoes and the tonnage of the vessels is now so great that the time consumed in unloading and the cost of keeping the vessel in docks are very serious considerations. To deal with such a large amount of trade, the old method of working by hand has been gradually replaced by the use of various machinery, such as the endless band, carrying a number of comparatively small buckets travelling at a speed of about 100 feet per minute in an enclosed trunk, and which has for some years been in use in America, in Liverpool and elsewhere; but where the cargoes to be discharged are of a mixed character, e.g., general goods and packages in the 'tween decks, and grain in bulk in the lower hold, it has been found more convenient to use hydraulic cranes with self-opening and closing grabs, or buckets filled by hand and self-discharging, or other contrivances with which to lift the grain, but which can at any time be exchanged for slings or hooks for the discharge of the ordinary merchandise. In all these methods, however, it is only possible to reach such of the grain as is within the area of the hatch; the other portion, which may extend 100 ft. or more fore or aft, has to be trimmed to the hatch by manual labor or by the so-called steam shovel. Grain is often brought in bunkers and other confined spaces in which it is not practicable to employ either of these machines, and so the grain in these places has to be filled into sacks and unloaded by manual labor. But when one has to deal with present-day vessels of 10,000 tons capacity, representing a capital expenditure of £70,000, and a debit of £70 for each day in dock, it is of very great importance to increase by every possible means the speed with which their cargoes can be loaded or unloaded. In this direction the skill of the naval architect has been shown, and must still continue to be shown, in so designing the vessels that they may not only be safe and otherwise satisfactory for navigation, but present the greatest facilities obtainable for the receipt and delivery of their cargoes.

It is also of importance that such improvements be made in the machinery employed that the greatest amount of work may be done in the shortest time and at the lowest cost, with safety. It was with such requirements in view that the author directed his attention to the employment of air for elevating and conveying bulk grain. There was no originality in this idea—air under vacuum, as well as under pressure, had from time to time been tried in this country and abroad for this purpose; but several difficulties presented themselves and prevented the successful operation of the machinery. Prominent among these were the difficulties of sucking or forcing grain in bulk through pipes, of getting the grain out of any vacuum chamber into which it had been drawn, and of separating the grain and its dust from the air which had conveyed it. The author feels that he need not give in uninteresting detail the various steps by which these and other difficulties were overcome, but would at once refer to two types of pneumatic elevators now in successful operation. One of these is employed for the discharge of sea-going vessels overside into barges at the Millwall Docks and the Albert Docks, London, Bremerhaven, Hamburg, etc. In these the machinery is afloat in a hull of, say, 80 feet by 24 feet by 10 feet; in each the machinery under deck consists of a compound engine connected direct with air-exhausting pumps capable of producing and maintaining a partial vacuum 15 inches of mercury in a tank into which, say, 5,000 feet of air, under atmospheric conditions, is being admitted per minute. The boilers are of the ordinary marine type; the engines are surface-condensing. On the deck of the craft, one, or in some cases, two or three towers are erected each to support a vacuum tank, which acts as a grain receiver, and is say, 10 feet in diameter by 16 feet high. This tank is coned at the

* From a paper read before the Institution of Naval Architects.

bottom, and has connections for two or three pipes through which the grain is drawn with the current of air from the hold of the ship. An automatic air-lock is fitted through which the grain discharges itself from the tank into the hopper of the weighing machines, and after weighing, it flows into the barge in bulk, or it may be sacked and delivered in that way. The men required for the discharge of, say, 100 tons per hour, are an engineer, a stoker, one man to each of the pipes, a leading hand, and three others for moving barges and general work. The coal consumption is about 5 cwt. per hour. This is heavy compared with the coal consumed by the ordinary bucket elevator, but as this pneumatic machine effects a direct saving of the cost of trimming the grain to the hatchway, the comparatively greater coal consumption sinks into insignificance. In fact, the whole operation of discharging is often less than what would have been the cost of trimming alone.

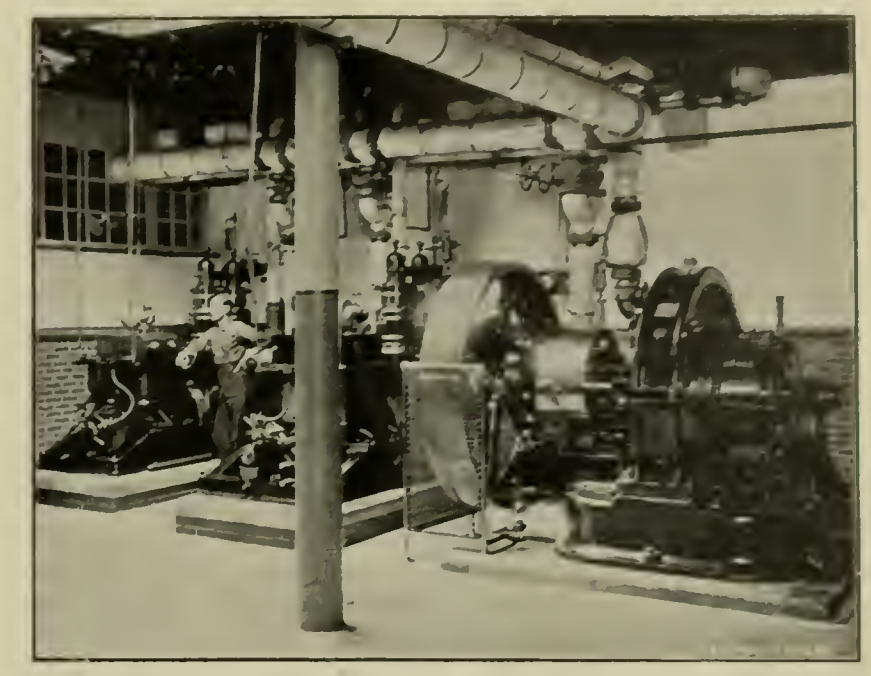
The pneumatic machine has moreover other advantages; it is worked in all weathers; it not infrequently happens that the pneumatic grain elevators are the only ship-discharging appliances at work on a wet day on the Thames. In addition to this important saving of the ship's time, it is also to be noted that the suction pipes, being suspended from the elevator derrick, can be lowered into the ship's hatchway and the discharge commenced within a few minutes of the machine being brought alongside. There is none of the usual loss of grain in handling, as the cargoes are conveyed within closed conduits from the discharging ship into the receiving barge, and the grain is, moreover, improved by such intimate contact with the conveying air. This is specially so when the grain is heated and out of condition. The suction pipes, which are semi-flexible, can be taken by any tortuous route into the bunkers or other confined spaces, and the grain can be drawn out therefrom almost as readily as from the ship's hold. There is obviously an entire absence of the dangers to life and limb that are inseparable from the ordinary lifting machinery. The elevator vessels are fitted with steam capstans to assist in moving themselves, as well as the barges that come alongside for loading.

IMPROVEMENTS IN THE ELECTRICAL PLANT AT McGILL UNIVERSITY.

The university has again to thank W. C. McDonald for generously defraying the cost of extensive alterations and additions to the light and power station, connected with the faculty of applied science. The equipment is now installed in a handsomely finished,

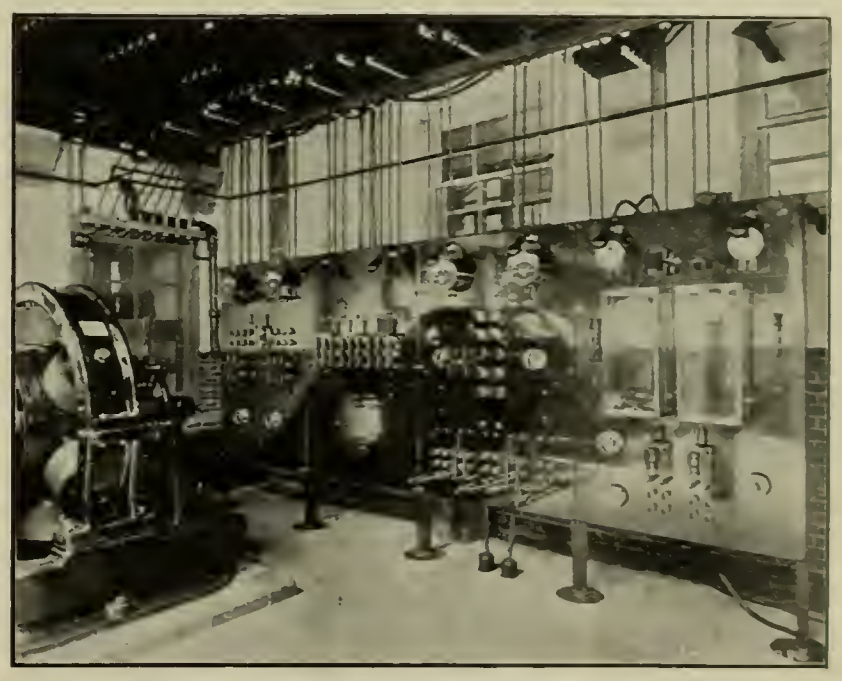
L. Herdt, B.A.Sc., E.E., Lecturer in Electrical Engineering, McGill University.

well-lighted room, and consists of a 30 k.w. Edison-Hopkinson dynamo, and a 30 k.w. Siemens dynamo, each driven by a Willans high speed engine; the dynamos are on the shaft of the engine, making what is known as direct connected units. These two machines are capable of lighting the different buildings of the university, supplying current for more than 3,000 lights. The dynamos are run in series on the three-wire system, or if the load is light, one can run on the two-wire system. In addition there are installed a 100 h.p. Goldie & McCulloch engine, directly coupled to a 75 k.w. General Electric dynamo. This machine is set apart for power purposes, the motors in the building averaging about 110 h.p. It may be also used for lighting purposes when the demand exceeds the capacity of the two former dynamos. The switchboard is made of dark slate in panel form, and it is said to be one of the finest in Canada. The lighting of the buildings at night is effected by the help of accumulators. The accumulator room, standing beside the dynamo room, possesses two batteries of Crompton-Howell storage cells, of a united capacity of 800 ampere hours. These batteries would discourage the antagonism of the adversaries of accumulators, for they are subjected to all kinds of discharges, and after a usage of over six years have an all-round efficiency of 72 per cent. An ingenious arrangement, devised by Louis A. Herdt, lecturer in electrical engineering, enables one battery to be



Electrical Plant—McGill University.

taken out of circuit, and the other one to be put in circuit during the night, as soon as one of the batteries shows signs of being discharged. The plan of the new dynamo room is such as to permit of the plant being extended so as to light any further buildings that may be erected or any of the existing buildings, such as the Library and Museum, which are at present lighted from other sources.



The Switch Board—Electrical Plant at McGill University

To increase the educational advantages of the mechanical engineering department especially, two of the battery of four Babcock & Wilcox boilers have been replaced by a boiler of the Lancashire type, and one of the Locomotive type. Both the new boilers were made in Canada, one by John Macdougall, the Caledonia Iron Works, Montreal, and the other by the Robb Engineering Co., Limited, Amherst, Nova Scotia.

SEWAGE DISPOSAL BY SUBSOIL IRRIGATION.*

By E. Mohun, M. Can. Soc. C.E.

In October, 1894, the author received instructions from the Hon. the Chief Commissioner of Lands and Works to devise some means for disposing of the sewage of Government House, Victoria, B.C., and though the work undertaken is but on a small scale, he trusts that it may prove of interest. It was found that the sewage of the building had been disposed of by the simple expedient of running a 6-inch pipe across a field and discharging into the street ditch, thereby creating an intolerable nuisance. The sewerage system of the city had not been extended in that direction, and to make connection with the nearest point it would have been necessary to construct a sewer about 3,600 feet long, nearly all the trenching for which would have been through solid rock. The contour of the ground being adapted to the purpose, it was decided to dispose of the sewage by subsoil irrigation. Reference to the books of the water department showed that the house consumption as taken by metre was remarkably small, frequently not exceeding 300 gallons a day.

* A paper read before the Canadian Society of Civil Engineers.

The only pipes available were 6-inch circular drain pipes, T pipes, and 3-inch circular drain tiles. At a convenient point in the field the old sewer was cut, and an automatic flush tank built, from which the sewage passed down a tight 6-inch conductor to the inlet ends of the 3-inch drain tiles.

In laying the drain tiles the following method was adopted: Contour lines having been set out with the level and the trench cut along them, bricks were laid with a carpenter's level 8 feet long, so as to form level and solid bearings beneath the ends of the drain tiles laid upon them.

The connection with the six-inch conductors was made by turning down a 4 × 6 T, and making connection with the drain tiles by means of a galvanized iron taper. The ends of all the drain tiles are provided with air vents, made by galvanized iron, and connected with the drain by quarter bends. The area irrigated is nearly one acre, and it has not been found necessary to underdrain, as the whole of the discharge appears to be absorbed by the earth. The total length of the drain tiles is 1,463 feet, and from their upper surfaces are from 10 to 12 inches below the ground surface. Their alignment is marked on the ground by lettered stakes. The flush tank is provided with an L screen, ¼ mesh, divided into three compartments by weirs; into the first the sewage discharges directly through the old pipe; as the screen becomes clogged with paper it overflows into the second compartment and similarly into the third. It has not been found necessary for the scavenger to clear the screen more often than once in six weeks, though for other reasons it is done once a month. No offensive smell can be detected either at the flush tank or on the lines of pipes, nor is there any indication of excrement sodden soil. The gardener states that the ground never before produced vegetables equal to those grown since the sewage system was installed.

The ground to the north-west is considerably higher than the field and garden, and is very rocky. Shortly after the completion of the work, snow fell, and within a few hours a rapid thaw took place accompanied by heavy rain, the water actually running over the surface in a sheet. Under the circumstances the tile drains became surcharged, and when the rush from the flush tank took place it can hardly be considered wonderful if three or four of the tiles were broken. They were of course easily replaced, and a similar occurrence guarded against by cutting an intercepting ditch across the field to lead the surface water into the street ditch. An object sought to be arrived at was to so proportion the tank that each discharge would fill all the drains, practically, simultaneously.

The cost of labor was high, a good deal of rock being met with in laying six-inch conductor. The work was performed by day labor under the author's instructions, and its cost was: Material, $255.68: labor, engineering, etc., $244.30; total, $499.98.

THE POSSIBILITIES FOR SMELTING IN BRITISH COLUMBIA.*

BY R. A. HEDLEY, NELSON, B.C.

My knowledge of the country and my study of its ores enables me to make certain statements, which I feel myself qualified to make somewhat authoritatively. My data, however, are insufficient to handle the subject very thoroughly.

Lead smelting offers some difficulties for any plant possible with present production of the lead producing mines. First, its capacity would not warrant the erection of a complete refinery, and without it lead must be refined in the United States, paying a duty of two cents per pound, while lead in ore pays but 1½ cents per pound. As the bulk of the lead ore shipped is of high grade (over 65 per cent. lead) this renders it difficult to compete with the smelters of the United States, as the difference in freight paid is but slight. To illustrate this point, let us suppose that ore is shipped to the United States carrying 65 per cent. lead. Assume freight at $8 per ton, duty is $19 50, making $27.50. Smelted here, bullion shipped at same freight rate will pay $5 20 and duty will be $26, making $31.20. It would seem, then, better to leave a high grade lead ore severely alone, unless the product can be disposed of to better advantage than by refining in the United States, paying duty on lead. Suppose a 40 per cent. lead ore shipped; it will pay freight, $8, and duty, $12, making $20. Smelted in this country and bullion shipped, freight will be $3.20 and duty on lead $16, making $19 20.

This is in favor of smelting as regards these two items of cost. Now the ores carrying 40 per cent. lead or less are as yet but a small item, and generally speaking carry a high percentage of zinc, or else the gangue is a barren silica, making fluxing costly.

The production of the whole Slocan district may be roughly stated at 100 tons per day, of which 60 per cent. is of high grade, over 65 per cent. lead, and 25 per cent. at least, carries fully 15 per cent. zinc. The question of flux is an important one in considering the treatment of these ores. Lime is very abundant, of good quality and cheap, but iron oxide of fair purity does not occur, and metallic iron as scrap is procurable in but limited quantity at the rate of $15 per ton. The ores of Rossland district have been spoken of as suitable for fluxing lead ores, but that is a very questionable point. An average Rossland ore will carry excess silica, and no little arsenic, and they strike me as an expensive flux when the cost of roasting is considered. Also the difficulty of making a good roast cuts some figure in the cost of treatment. A complete roast on a mixture of galena and pyrites, enables one to charge a certain proportion of raw galena ore, a manifest saving. Until recently, I was firmly convinced that a blast furnace matting plant would handle the ores of Rossland camp very economically and to great advantage. I still believe so, though I consider the difficulties are not few.

I have no definite information regarding the treatment of Le Roi ore at the Trail smelter. Would like to be able to state to what degree of concentration they attain, and what proportion of calcined ore they use on the charge. Having analyzed samples from many of the mines, I am of the opinion that, given an assortment of ores from different mines, matte smelting can be successfully and economically carried on. The consumption of fuel and flux should be kept very low, and as these two items form by far the major portion of the cost of first concentration, it is of importance to determine whether 10 or 15 per cent. is necessary. A year ago I was told that they were using but 10 per cent. of coke, and I analyzed a piece of slag produced without extraneous flux, finding:—

Silica	49.2 p.c.	Gold .045 ozs. per ton.
Ferrous oxide	23.2 p.c.	
Alumina	14.9 p.c.	
Lime	5.7 p.c.	
Magnesia	5.4 p.c.	

It would be very interesting and instructive to see pyritic smelting thoroughly tested on these ores, with a well adapted plant. It may be said that pyritic smelting has never yet proven a success, but it has never yet had a fair trial. In Newfoundland, it has been stated that purely pyritic smelting was successfully carried on, but the ore treated, if I understand aright, carried very little slag forming material, and therefore, the concentration was low. Professor James Douglas made a trip expressly to see that plant in operation. Robert Sticht wrote at length on the subject, and described the operations of plants at Boulder, Kokomo and Toston, stating that there were obvious reasons why they were not successful, either through faulty plant or ores unsuitable.

As yet we do not know what the Rossland mines are capable of producing. Wild statements have been made on this head, but I believe that a 500-ton plant, erected at such a point and run so economically that it could make a smelting rate of $7 per ton f.o.b., Rossland, would soon have to increase its capacity. If these ores will smelt with a concentration of 10 to 1, using 12½ per cent. coke and 10 per cent. flux (limestone), that figure will leave a profit to the smelter. Speaking of possibilities, however, I consider that they are far greater in the Boundary Creek district. There, the variety is greater, and a perfectly self-fluxing ore is obtainable. I do not pretend to say that there is an abundance of ore of such grade as to maintain a large plant but I do say that there is every indication that such will prove to be the case. Once transportation is had, development will be pushed and plants will follow. Ores will be treated, both by direct smelting for matte and by previous concentration. There are very clean ores of mixed pyrites, chiefly pyrite and chalcopyrite, that will carry 8 to 12 per cent. copper and low silica; others of low pyrites and gangue, that will form an excellent slag.

Should the coal, on development, prove to be of good coking quality and in sufficient quantity, a plant with large capacity will treat ore as cheaply as anywhere on the continent. Even bringing in coke at a cost of $12 per ton laid down, I have no hesitation in stating that a 500-ton plant (two furnaces) using steam power, will smelt at a cost not to exceed $2.75 per ton of ore. This of course will produce matte the grade of which will depend on the degree of concentration and the percentage of copper in the ore.

In order to get at the margin on treating a ton of ore, let us assume certain values, and figure the cost by shipping matte, and also converting to copper, and shipping for electrolytic treatment, assume:

4 p.c. copper, at 10c.	$ 8 00	
4 dwts. gold, at $1	4 00	
4 ozs. silver, at 50c.	2 00	
		$14 00

Shipping matte: 40 p c. copper, conc. 10 into 1.

Freight to New York	$18 00
Deduction: 3½c. per lb. copper	28 00
5 p.c. of silver	1 00
	$47 00

* A paper read before the Federated Canadian Mining Institute.

Representing 10 tons of ore, or per ton	$ 4 70	
Blast furnace treatment, per ton	2 75	
Losses, say 7½ p.c. (excessive)	1 00	
		$ 8 50
Leaving a margin to miner on $14 ore		$5 50
Or converting 40 p.c. matte to metallic copper.		
Roasting and reverberatory furnace work, per ton of copper	$30 00	
Marketing one ton of copper	40 00	
	$70 00	
Representing 25 tons of ore, per ton	$2 80	
Blast furnace treatment	2 75	
Losses on treatment, say 10 p.c. (excessive)	1 40	
	$6 95	
Leaving a profit to miner on $14 ore		$7 05

You will observe that for the purpose of facilitating these calculations, I have taken my copper value at 10c. per pound. It is customary to figure at $1 per unit, or 5c. per pound in ores, which would make this a ten dollar ore. That there is every indication that such grade of ore will be developed in enormous quantity, I am sure most mining men familar with the country will agree. With East Kootenay I am not familiar, but I believe that the range between Kootenay Lake and Fort Steele will produce ores that after concentration will materially assist smelting operations in the country. West again of Boundary Creek, in the Okanagan country, I have seen evidence of ores in veins of unusual size, that will yield handsomely. The coast too, if report be true, has its ores of character suitable for smelting, and exceptionally situated for economical treatment.

My figure on converting 40 per cent. matte to copper and marketing that, seems abnormally high, but it is based on roasting in the hearth furnace by expensive hand labor, and can be greatly reduced by automatic machinery. The New York market being the best, necessitates a high freight, and if all values are paid for they must charge a good treatment rate.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during April and the four months ending April, 1897, 1898:—

	Month of April.		Four months ending April.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£5,899	£2,694	£17,917	£8,112
Pig iron	.. ..	2,683	455	5,224
Bar, etc.	858	1,682	3,889	3,967
Railroad	9,504	50	13,351	6,972
Hoops, sheets, etc.	4,608	1,817	11,009	5,470
Galvanized sheets	6,182	9,522	12,023	14,071
Tin plates	10,778	14,996	72,320	40,545
Cast, wrought, etc., iron	4,081	4,117	11,085	10,250
Old (for re-manufacture)	.. ..	495	572	898
Steel	4,752	3,486	14,987	19,421
Lead	712	1,602	2,782	4,305
Tin, unwrought	1,872	2,454	7,316	5,930
Alkali	3,667	6,042	8,189	11,558
Cement	1,110	3,503	2,953	5,491

CANADIAN ELECTRICAL ASSOCIATION.

The following is the programme of the convention of the Canadian Electrical Association, to be held at the Windsor Hotel, Montreal, this month:

BUSINESS PROGRAMME.

Tuesday, June 28th.—9.30 a.m.—Meeting of Executive Committee. 10 00 a.m.—Opening of the first session in Convention Hall, Windsor Hotel; President's address; reading minutes of last meeting; secretary-treasurer's report; reports of committees and general business. 2.00 p.m.—General business; presentation of papers; discussion.

Wednesday, June 29th.—9.00 a.m.—Consideration of reports of committees; election of standing committees; selection of place and time of next meeting; general business; presentation of papers; discussion.

Thursday, June 30th—9.30 a.m.—Election of officers.

LIST OF PAPERS.

"How to Overcome Some of the Difficulties Encountered by Central Station Men," A. A. Wright, Renfrew, Ont. (1) "The Unconscious Ownership of an Important Key"—(A Plea for the Introduction of Goods Traffic on our Suburban Tramways); (2) "The Quimby Electric Screw Pump," W. T. Bonner, Montreal. "Experiences of an Inspector," Dr. J. K. Johnstone, Inspector of Electric Light, Toronto. "The Electric Current in the Rainy River Gold Mines," W. W. Hopkins, B.Sc., C.E., etc. "The Importance of Proper Methods of Illumination," F. A. Bowman, M.A., B.E., New Glasgow, N.S. "Economics in the Boiler Room," James Milne, Toronto. P. G. Gossler, Montreal, is also expected to read a paper.

SOCIAL FEATURES.

Tuesday, June 28th.—7.30 p.m.—Trip around Mount Royal by special Park and Island cars, afterwards ascending Incline Railway to lookout on mountain to view the city under illumination.

Wednesday, June 29th.—1.00 p.m.—Visit to (1) Bell Telephone Company's new building; (2) Street Railway Company's power house, (3) power house and works of the Lachine Rapids Hydraulic and Land Company, returning to city at 7.30 p.m. 9.00 p.m.—Annual association banquet at Windsor Hotel.

Thursday, June 30th.—11.00 a.m.—Visit to McGill University. 1.30 p.m.—Visit to Royal Electric Company's lighting station and factory, then by special G.T. train to visit the works of the Chambly Manufacturing Company at Chambly.

FIRES OF THE MONTH.

May 1st—S. Buyant's sawmill in Tecumseth, Ont., together with 50,000 shingles. No insurance.——May 4th—The factory and manager's house of the Truro Condensed Milk and Canning Co., Truro, N.S. Loss $55,000; insurance on stock and buildings $35,000.——May 7th—One of the Canadian Gold Field Co.'s buildings at Deloro, Ont. Damages, $75,000; insurance, $41,000.——May 8th—Premises formerly occupied by Ontario Pump Co., Cecil st., Toronto, destroyed. ——May 10th—J. H. Connor's washing machine factory, Sussex st., Ottawa. Loss about $10,000.——May 17th—McBuril's furniture factory at Moosomin, N.W T. The loss on the furniture factory is $5,000; no insurance.——May 25th—The Thornbury, Ont., woolen mills, completely destroyed; supposed to be incendiary; insured for $5,000.

LITERARY NOTES.

There has just been published the second edition, revised and much enlarged, of "Gas, Gasoline and Oil Engines," by Gardner D Hiscox, M.E. This is a book designed for the general information of every one interested in this new and popular motive power, and its adaptation to the increasing demand for a cheap and easily managed motor requiring no licensed engineer. The book treats of the theory and practice of gas, gasoline aud oil engines, as designed and manufactured in the United States. It also contains chapters on horseless vehicles, electric lighting, marine propulsion, etc. The following are the subjects discussed:—History of the system, theory of the gas and gasoline engine, utilization of heat and efficiency in gas engines, heat efficiencies, ratarded combustion and wall-cooling, causes of loss and inefficiency in explosive motors; economy of the gas engine for electric lighting; the material of power in explosive engines, gas, petroleum products and acetylene gas; carburetters, and vapor gas for explosive motors; cylinder capacity of gas and gasoline engines, mufflers on gas engines; governors and valve gear; igniters and exploders, hot tube and electric; cylinder lubrication; management of explosive motors; measurement of power by pony brakes, dynamometers and indicators; measurement of speed, the indicator and its work; vibrations of buildings and floors by the running of explosive motors; explosive engine testing; various types of gas and oil engines, marine and vehicle motors; United States patents on gas, gasoline and oil engines, and their adjuncts—1875 to 1897 inclusive; list of the manufacturers of gas, gasoline and oil engines in the United States, with their addresses.

"The Making of the Canadian West," is the title of a new contribution to Canadian history, by the Rev. R. G. MacBeth, M.A. This is the second appearance of the author before the Canadian reading public, and his pursuit of historical work is amply justified by the warm reception given to his first effort recently published under the title of the "Selkirk Settlers in Real Life." This was a description of the mode of life and surroundings of the early settlers in the region now known as the Province of Manitoba, and the story told by one who lived among them, was so life-like and charming that the reader longed to know more of the leading actors in this interesting drama of colonization. Hence the present book, which gives graphic sketches of the leading men who figured in the political and social life of the Selkirk settlement. To use the words of the author in his preface, he has simply gone back and lived through the past again, seeing the faces and hearing the voices of other days, and what he has seen he has written. The result is a most valuable contribution to Canadian history, and the work is embellished with portraits of some ninety individuals, more or less prominently associated with affairs in the North-West. The author's style is easy and unaffected, and his sketches have a life and force derived from personal experience and

observation. The work is dedicated to Lord Strathcona, whose portrait appears as a frontispiece. The publisher is William Briggs, Toronto, a name which is invariably associated with good typography. We warmly commend this excellent book.

"The Pioneers of the Klondyke," which is an account of two years' police service in the Yukon before the country became so well known as it is now, is narrated by M. H. E. Hayne, of the North-West Mounted Police, and written by H. West Taylor. The illustrations, which are numerous, are from photographs taken on the spot by the narrator. The typography is excellent, and the whole volume is worthy of the publishers, Sampson Low, Marston & Co., London, England.

The Engineering Society of the School of Practical Science, Toronto, has issued its annual volume of papers read before the society during the year. Among the contributors are . A. W. Campbell, C.E.; P. H. Bryce, M.A., M.D.; W. M. Minty, B.A.Sc.; L. B. Stewart, D.T.S., and others.

We have before us proofs of a paper read before the Society of Arts, London, England, by Edwin O. Sachs, on "Stage Mechanism," which gives a valuable insight into some of the underlying principles of this most necessary adjunct of the mimic art.

The Rand Agency, Ltd., Johannesburg, S.A.R., has sent us the list of members and associates of the Chemical and Metallurgical Society of South Africa.

Industrial Notes.

Clinton, Ont., will probably buy a steam road roller at an early date.

Ottawa city council has passed plans for main drainage system to cost $414,000.

Berlin, Ont., has passed a by-law to buy the waterworks from the local company.

Craig Street, Montreal, is to be repaved with scoria blocks at a cost of $73,500.

The Gartshore-Thomson Pipe and Foundry Co., Ltd., has increased its capital to $60,000.

Wm. Stokes, Amherstburg, Ont., proposes to establish a cold storage plant in Windsor, Ont.

The Diamond Glass Co., Ltd., is applying for power to increase its capital to $1,000,000.

The Brompton (Que.), Bridge Co. is about to build a new bridge with iron superstructure.

The Bushnell Oil Company is enlarging the Sarnia refinery so as to almost double its capacity.

The House of Industry, Bradford, Ont., will have two wings added this summer, at a cost of $13,000.

A great deal of permanent pavement will be laid in Guelph, Ont., this summer, chiefly cement sidewalks.

The Canadian Brewing Company, Montreal, is installing a new steam plant using the Kingsley water tube boilers.

Peterboro will soon vote on a by-law authorizing the issuing of debentures for the purchase of a steam road roller.

A flood-prevention dyke is proposed by the city engineer of Brantford, Ont., T. Harry Jones, C.E., to cost $47,583.

The Bennett & Wright Co., Ltd., Toronto, is to put in the plumbing and sewage of the House of Industry, Bradford, Ont.

A. N. Bishop, Annapolis, N.S., is enlarging his sawmill, and has bought an engine and boiler from the Goldie and McCulloch Co., Galt, Ontario.

The McEachren Heating and Ventilating Co., Galt, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a Dake engine.

The Western Loan and Trust Co., Montreal, is installing a new heating system in its building, using the Kingsley water tube boiler. David Ogilvy is the architect.

The MacGregor-Gourlay Company, Galt, Ont., has completed the purchase of the London, Ont., Machine Tool Company's business, and will transfer the business to Galt.

J. R. Booth, president of the Ottawa, Arnprior and Parry Sound Railway, has stated that he will not, at present, build a large flour mill at the Chaudiere, as had been reported.

The Consumers' Gas Co., Toronto, is building brick and stone steel skeleton retort house, Parliament st., Toronto. Bond & Smith, Temple Building, Toronto, are the architects.

N. P. Tanguay, Weedon, Que., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a Crocker Turbine complete with gate, draft-tube and gearing for his sawmill at that place.

The Great North Western Telegraph Co. is installing a new heating system in its large building in Montreal, using the Kingsley water tube boiler installed by E. A. Wallberg, Montreal. David Ogilvy is the architect.

Ed. Mohun, C.E., Victoria, B.C., has made an examination of Rossland, B.C., with a view to scientific sewage disposal, and has reported in favor of a sewage farm below the town, with settling tanks to collect the solids.

G. B. Burland. Montreal, has installed a Kingsley water tube steam boiler plant in the Union Card and Paper Co.'s new works. This is the second order that Mr. Burland has given for Kingsley boilers after using them for four years.

It is reported that a European petroleum syndicate, which controls the immense oil wells at Baku, has purchased the property of the Newfoundland Oil Co., situated on the West Coast of Newfoundland. The price paid is said to have been upwards of $400,000.

The work on the large C.P.R. station and office building in Vancouver, B.C., and the C.P.R. Hotel, at Revelstoke, is progressing rapidly. Most of the materials are procured in the West, and the steel structural work is supplied by E. A. Wallberg, Montreal.

John McDougall Ltd., Caledonia Iron Works, Montreal, had a contract for water filtration with the town of Windsor, N.S., which was set aside by the water commissioners upon a vote of the citizens. They brought suit and recovered the full amount for work done.

If Brantford and Kingston do not grant large bonuses to the Dominion Cotton Mills Co. the factories of the company will probably be concentrated at Three Rivers, Que., where electric power can be had from the Shewanegan Falls. About 5,500 hands are now employed

The Frost Wedge-Lock Wire Fence Co., Cleveland, Ohio, intends starting a branch in Canada, and is corresponding with Welland, Ont., to ascertain what inducements the town is prepared to offer. All the company ask is 1,500 to 2,000 square feet floor space and six-horse power.

The Montreal contracting and building firm of A. Lebeau & Co. has assigned with liabilities aggregating some $60,000 in all, some $55,000 of which is due on mortgage. A demand of assignment was made in March, which they contested, but a second demand results in an abandonment of their estate.

The Laurie Engine Co., has recently installed in its works a high pressure compound Corliss Engine and a Kingsley water-tube boiler plant designed for 175 lbs. working pressure. This is considered in every way a model and a highly economical plant. The Kingsley boilers are installed by E. A. Wallberg, Montreal.

F. B. Gaylord, W. Gerhauser, S. T. Miller, F. A. Goodrich and A. O. Cowles, Detroit, U.S., and E. W. Rathbun and F. S. Rathbun Deseronto, Ont., have been incorporated as the Deseronto Iron Company, Limited, to carry on, in all their branches, the operations of mining, milling, reduction and development, with a capital of $990,000.

The General Engineering Co., of Ontario, Limited, has published a neat volume "Smokeless Heat," which describes the mechanism and application of the Improved Jones Underfeed Mechanical Stoker. A large number of these stokers have already been installed in the large power plants in Toronto and the neighborhood with most satisfactory results, it is stated.

A. C. Hutchinson, architect, Montreal, recently had tests made of the new Kingsley water tube boilers in the Ottawa General Hospital These tests gave highly economical results, exceeding the maker's guarantees by 10 per cent This type of boiler was used in nearly all the recent Ottawa work, including the American Bank Note Co.'s Works, the C. Ross Co.'s building, the Russell Theatre, the Sun Life Insurance Building, the Hotel Cecil, the Harmony Hall, and the Grand Opera House. These boilers were installed by E. A. Wallberg, Montreal.

Belleville, Ont., has been negotiating for the removal of the Thames Iron Works from Norwich, Connecticut, to that place, and has on the report of a deputaiton which visited Norwich, unanimously resolved to submit to the electors a by-law granting a bonus of $50,000, a site of ten acres, free water, exemption from taxation for ten years, and to pay the duty on the plant, which will be removed from Norwich. The company, the chief member of which is F. Mitchell, will first erect a rolling mill, and subsequently, if profitable opening be found, a smelting furnace, nail factory, etc.

The Alberta Railway and Coal Co. has lately caused a survey to be made of the lands lying south of Lethbridge, and proposes to put in irrigation ditches. As the country is adapted in every sense for

irrigation, this will open up for cultivation an immense tract of land, which at present is only used for grazing, owing to its dryness. Where water has been applied in gardens the growth has been very luxuriant. It is expected that on completion of the system there will be a large influx of settlers from the United States, who understand and appreciate irrigation better than Canadians. The Kootenay market for hay, oats, vegetables, etc., will be quite close to this land.

The old suspension bridge across the Niagara River, connecting the Queen Victoria Park with Niagara Falls, N.Y., has been converted into an arch bridge of the same model as the Grand Trunk's new single-arch bridge. The steel arch was built up from either side of the river directly under the platform of the old bridge, and the work of alteration did not obstruct traffic over the bridge, except for a very short time. Both the arch bridges across the Niagara were designed and built under the supervision of L. J. Buck, C.E., New York. The new bridge is of the same pattern as the one built for the Grand Trunk, but is larger and has a greater span of arch, but is not calculated to sustain such heavy traffic as crosses the railroad company's bridge. The steel arch of the new bridge has a span of 840 feet, and the full length of the bridge is 1,240 feet. The length of the arch in the Grand Trunk bridge is 550 feet, and the length of the bridge, including approaches, is 1,100 feet. The centre of the new bridge is 190 feet above the river. The material of the old suspension bridge is to be used in the construction of a new suspension bridge across the Niagara River from Lewiston to Queenston.

The tenderers for the Port Colborne, Ont., waterworks, in whole or in part, are: St. Lawrence Foundry Co., Toronto; Londonderry Iron Co., Nova Scotia; Adam Hope & Co., Hamilton; Gartshore, Thompson & Co., Hamilton; Hamilton Fire Escape Co., Hamilton; Drummond, McCall & Co., Montreal; Kerr Engine Co., Walkerville, Ont.; Rumsey & Co., Seneca Falls, N.Y.; Northey Mfg. Co., Toronto; Goulds Mfg. Co., Seneca Falls, N.Y.; J. W. Ruger Mfg. Co., Buffalo; Walsh Boiler Works, Springfield, Mass.; R. Brown & Sons, New Glasgow, N.S.: C. Richmond, Humberstone; Hunter Bros., Kincardine, Ont.; Geo. W. Moore. Buffalo; J. G McKay, Thamesville, Ont.; W. B. Wilson, Buffalo; J. E. Kennedy, Owen Sound, Ont; Clark & Connelly, Toronto; McQuillan, & Co., Toronto; W. W Reid, Niagara Falls; Craig & Lynch; Hill & Gowanlock, Toronto; Fairbank, Morse & Co. The following are the lowest tenders: For cast iron pipes, hydrants, valves, etc., St. Lawrence Foundry Co., Toronto, $7,255 50; for complete system, Clark & Connelly, Toronto, $17,800; McQuillan & Co., Toronto, $18,960; Hill & Gowanlock, $16,899. Lowest figures, taking separate bids for completed work, $16,503 78. Pumping station was W. B. Wilson, Buffalo, $900. For stand-pipe, Walsh Boiler Works, Springfield, Mass., $995.

Mining Matters.

During one fortnight recently over forty miners left Johannesburg for the Klondyke.

The discovery of rich gold-bearing deposits is reported from Lake Clare, twenty-one miles north of Ste. Anne de Chicoutimi, Que.

The Jenckes Machine Co., Sherbrooke, Que., shipped on the 5th inst. a complete 10-stamp mill to the Cariboo Mining, Milling and Smelting Co., Fairview, B.C.

The Jenckes Machine Co., Sherbrooke, has equipped the Athabasca Mine, Nelson, B.C., with complete hoisting outfit and boiler. This mine is sure to become a producer of prominence.

D. S. McArthur & Co., Nelson, B.C., are developing their properties, and recently purchased, through the Rossland branch, from the Jenckes Machine Co. a complete hoisting plant.

The Monte Cristo Mine continues sinking in the main pit, and has lately added a No. 6 Cameron vertical pump, purchased through the Rossland branch, from the Jenckes Machine Co., Sherbrooke, Que.

The Rat Portage Diamond Drill Company has shipped machinery to Shoal Lake, where work has been commenced on the Cornucopia property.

Rossland, B.C., has organized a mining school by means of local subscriptions. About sixty students began the study of geology there early in April.

Mining in Newfoundland is likely to become more active very soon. The agents of at least five wealthy companies are at present in the Island examining properties, chiefly copper, with a view to purchase.

The Dundee Mining Company, Rossland, B.C., has just let a contract for furnishing material for a three-line gravity tramway. The price is $1,400. The company will erect trestles and install the tramway.

The Bonanza Nickel Mining Company at Wahnapitae, Ont., has erected a ten-stamp mill at the Mammoth gold mine, which is now in operation under the management of Henry Dierlamm, formerly of Chesley, Ont.

W. M. Slack, Petrolea, Ont., Fred. Beresford, London, and John MacRae, Petrolea, are on their way to Edmonton, N.W T., to test an oil well for the Dominion Government. They expect to drill 2,200 feet before they strike oil.

George Wilson, contractor, Kingston, Ont, has bought a large mica mine situated two miles back of Gananoque, Ont. The mine was opened some time ago, and $2,500 spent on it. Samples of the mineral show it to be of a superior quality.

The London and British Columbia Gold Fields Co., Ltd., Rossland, B.C., is developing its property, and recently added to its equipment a 6 x 8 special hoisting engine and 40-h.p. locomotive-type boiler from the Jenckes Machine Co., Sherbrooke, Que.

Prof. Frank D. Adams, professor of geology and paleontiology in McGill University, has declined, out of regard to the wish of the university, the position of Provincial Mineralogist of British Columbia, the position until recently held by Prof. Carlyle.

The Coleraine Mining Company is reorganized, and the new directorate has employed A. Davis, their consulting engineer, to put in a complete new plant for mining at Black Lake, Megantic, Que. The company has orders for the entire output for three years.

The Jenckes Machine Co., Sherbrooke, Que., recently supplied the Sydney mine at North Sydney, Cape Breton, with a special coal hoisting engine, to be operated by compressed air. The compressor was supplied by the Canadian Rand Drill Co., Sherbooke, Que.

Geo. M. Webster & Co., Quebec, coal handlers, are improving their facilities for unloading steamers, and for this purpose have placed an order with the Jenckes Machine Co., Sherbrooke, Que., for four of their double cylinder rapid coal-hoisting engines with boilers.

The Dominion Coal Co. is improving the facilities for unloading from its steamers at Levis, and has purchased for this purpose four 8¼ x 10 double cylinder special coal hoisting engines from the Jenckes Machine Co., Sherbrooke, Que., with a powerful 100-h.p. locomotive boiler.

The British American Corporation, Rossland, B.C., is pushing the development of its properties, and the Jenckes Machine Co., Sherbrooke, through its Rossland branch, has supplied it with special pumping apparatus for the Nickel Plate, and Columbia and Kootenay mines.

Manganese iron ore is freely imported into the United States from various countries in Europe and South America. Extensive deposits of this ore exist in New Brunswick and Nova Scotia, and it would appear that Canada is losing a profitable trade which is lying right at her doors.

The Smuggler Gold Mining Co., headquarters Toronto, has decided to put a 20-stamp mill on its property at Fairview, B.C., this summer, and an order has been placed with the Jenckes Machine Co., Sherbrooke, Que., for Corliss engine, boiler, 20 stamps, vanners and four miles of aerial tramway.

The Bell Asbestos Co., Thetford Mines, Que., is changing over the system of operating the mine hoist, and for this purpose has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a 100-h.p. steel tubular boiler, and have also purchased from the same company a small locomotive for shifting cars in pits.

The Canadian Copper Co., of Copper Cliff, Ont., is fitting a new shaft, has placed an order with the Jenckes Machine Co., Sherbrooke, for two 100-h.p. special steel boilers, one 12 x 15 double cylinder double drum winding engine, three large steam pumps and rock breaker, and necessary gear for operating them.

The annual meeting of the Newfoundland Oil Company was held recently, the majority of the shareholders being present, and President Thompson occupying the chair. The report of the Secretary-Treasurer which was presented and adopted was of a most satisfactory nature. The officers of last year were re-elected.

Supplementary letters patent have been issued by the Quebec Government granting the Combustible Gas Company an exclusive privilege of working and making use of the combustible gas which exhales in various parts of the province, for the purpose of lighting, heating, and supplying motive power until August 30th, 1901, inclusive.

E. T. Wilkie, C.E., Carleton Place, Ont., and Andrew Bell, C.E., Almonte, Ont, are in charge of the survey now being made for a tramway to connect the iron mines now operated by the Hamilton smelting works, in Darling township, Lanark county, Ontario, with the Kingston and Pembroke Railway at Flower Station. The line may be ultimately an electric railway.

A Rossland, B.C., report states that the recent strike on the Jumbo is a good one. The body of ore was struck in the lower tunnel, and the whole force of the working is said to be in rock assaying $113 to the ton. The tunnel referred to was started in August, 1896, and has now been run in 800 feet in the ledge. It is 200 feet below the ore body discovered two years ago, and gives a "back" of 350 feet.

Vancouver, May 5.—The city council has, subject to the ratifying vote of the taxpayers of Vancouver, agreed to pass a by-law granting to the Van Anda Gold and Copper Mining Company a subsidy of 40 cents a ton on ores smelted by it at a smelter to be built and operated at some point within five miles of the limits of Vancouver, the total subsidy payable to be limited to an aggregate of 125,000 tons, making $50,000 in all.

The Vancouver, B.C., city council has accepted the offer made by the Anglo Continental Public Works Company of London, Eng., and that city is to have a smelter. The proposition in brief was as follows: It is stipulated that the city shall give the company a bonus of 50 cents per ton on ore treated, not exceeding 30,000 tons in any one year, in return for which the company shall give the city £50,000 in preference 10 per cent. shares.

At Belle Island, in Conception Bay, Newfoundland, the Nova Scotia Steel Co. have developed extensive iron deposits. The company is the lessee of four grants of land, each of one square mile, and during the past few years have erected an extensive and costly plant for the mining and handling of the ore. The bulk of the ore has been shipped to New Glasgow, where it is mixed with Nova Scotia iron and produced pig iron. The company employs an average of 200 men, and the deposits are estimated to contain some 40,000,000 tons of ore and the assays give from 48 to 56 per cent. of metallic iron.

The directors of the War Eagle Consolidated Gold Mining Company have decided to begin paying monthly dividends of 1½ per cent. The first dividend is payable on 1st June. The company is capitalized at $2,000,000, in one-dollar shares, of which 350,000 still remain in the treasury. The June dividend upon the 1,650,000 shares in the hands of stockholders will total $24,750. The mine ships to the C.P.R. smelter at Trail 100 tons per day, or 3,000 tons per month. The smelter people buy the ore as it arrives, upon its assay value, the War Eagle netting about $17.50.

The Canadian Pacific evidently intends to supplement its network of railways in the Kootenay by a system of smelters. Having bought the Heinze smelter at Trail, B.C., the C.P.R. is now adding to its plant two new blasts, which will bring the daily capacity up to 500 tons It is also stated that the railway company will erect a lead smelter at Trail, the plant to be in operation before the first of next year. This lead stack will adjoin the property acquired from Heinze, and will have a capacity of 150 tons a day, the idea being to treat the Slocan and Ainsworth galena ores in conjunction with the pyrrhotite ores of Rossland camp.

At the annual meeting of the Toronto Smelting Company, Limited, which was held in Canada Life Building, Toronto, recently. James Kendry, M.P., was elected president; J. D. Hay, Toronto, vice-president; W. A. Hungerford, Belleville, general manager; F. C. Flannery, secretary-treasurer, The company proposes to establish smelting works at Madoc, if satisfactory arrangements can be made; if not, they will establish works at Duoro or Marmora. The company has already made tests at Millbridge, and the results have been so satisfactory that it has decided to erect a custom and testing smelter. The company intend to pay special attention to arsenic, as the mispickel ores of this region are especially noted for the production of arsenic.

The Ontario Bureau of Mines has received news confirming the reported discovery of placer gold near Sudbury. The finds are said to be on the Vermillion River, to the north of Sudbury, probably at the head waters of the river, near the Height of Land, west of Lake Wahnapitae. The Department has received numerous applications for mining location in this district recently, but none has been granted, as this part of the country has been withdrawn from sale on account of its valuable timber, which has not yet been disposed of by the Government. Some prospectors who have come out state that the gravel is abundant, but the pay is not high, and that only on a large scale would the diggings pay to work. Others say that three to five dollars a day can be easily taken out.

The Crow's Nest Pass Coal Company, Fernie, B.C., expects to be able to supply the smelters in Montana, Idaho, Northport, Trail and Nelson, which are at present using the Welsh coke, which costs them from $16 fo $18 per ton. The Crow's Nest Co. hopes that it will be able to furnish better coke to the two Canadian plants for $7 per ton. It will, of course, be higher delivered in the United Sates. The Crow's Nest coke is said to contain 95 per cent. fixed carbon and only 4 per cent ash. . It is estimated that by this reduction in the price of fuel the smelters will be able to save $1.50 per ton in the cost of treating ore. The present consumption of coke at the smelters which the company hopes to supply is as follows: Northport, 40 tons per day; Trail, 60 tons; Hall Mines, 40 tons; Everet, 60 tons; Tacoma, 40 tons; Great Falls, 150 tons; Helena, 50 tons; Butte and Anaconda, 400 tons. It will at the outset be called upon to furnish 840 tons a day.

A letter from Rossland under date May 11th gives some items of interest respecting what is doing in the Kootenay mining district. Development is active, and the hopes of both prospectors and miners appear to be high. The War Eagle mine proprietors have been negotiating with the General Electric Company about a compressor plant and elevator, and have at last closed a contract for the same. The Boundary Creek country is progressing up well, and a ten-drill compressor plant, with hoisting-engine, heaters and pumps, is under contract from the Cooper Company, of Montreal, to be furnished to the British Columbia Copper Company, of Anaconda. At the Le Ro smelter they are said to be running 250 to 300 tons of ore per day, principally from the Le Roi mine. At the Hall mines smelter, at Nelson, by their published report, the output for twenty days up to 30th April was 218 tons of matte from 4,734 tons of ore, where in 31 days ended 2nd April, they had turned out 357 tons matte from 7,437 tons of ore treated. The new superintendent of the smelter, R. R. Hedley, is proving his ability and has, it appears, done more successful work than either of his predecessors, even although he is a Canadian, born and educated outside of "Europe." The people here, or perhaps I should say some of the people here, did not like what Mr. Hedley said, in 1896, about the character of the Rossland ores, but he is proving to be about right in his estimates of what can and cannot be done with it. Other experts were planning and working on a basis of 60 and 65 per cent. copper matte. But the matte does not pan out anything of the sort. In fact the Hall Mines people are at present producing only a 45 per cent. copper matte, which is a very different story. It will give you an idea of the extent of the activities in this part of Kootenay, the writer says, if I tell you that, as I learned from the custom authorities, there was raised and shipped through the Nelson custom house 31,920 tons of ore, valued at $3,116,212 during the period from 1st January to 30th April, 1898. The banks are finding that it is worth while to look after business here, and I am told that the Bank of Montreal will very shortly erect a handsome three-story building in Rossland for banking premises and other purposes.

Marine News.

The Yarmouth Steamship Co.'s new steamer "Express" has been fitted up at Liverpool. She will carry 200 passengers and will arrive at Yarmouth early in June.

The Bertram Engine Works Co. have secured the contract to build a steel grain-carrying propeller to be used in place of the Rosedale. The new vessel is to be 255 feet long by 43 feet beam.

The Lake Champlain and St. Lawrence Ship Canal Company charter has been granted by the Dominion Government, but it is not to become operative without the consent of the Governor-General-in-Council.

L. Lacouture, Sorel; J. O. Blondin, La Baie des Peres; D. Gillies, M.P.P., Carleton Place, Ont.; J. Gillies and J. Gillies, Breaside, Ont., have been incorporated as the Lac Temiscamingue Navigation Company, Ltd., capital $25,000.

The port of St. John, N.B., did a much larger business during last winter than the one previous. Last winter there were 53 steamers sailed as against 46 the winter before, and there were 3,639,000 bushels of grain trans-shipped as against 1,436,000 bushels in 1896-97.

Capt. Macauley, of the Dominion liner "Canada," has been appointed to the command of the company's new steamer "New England." His successor will be Capt. Maddox, of the "Scotsman." The latter will be commanded by the second officer, Capt. Skrimpshire.

The large freighter built at Leigh's shipyard, Victoria, B.C., for Capt. W. Grant, was launched a short time ago The steamer is 107 feet in length with 24 feet beam and 7 feet deep. She will have a speed of eight knots and will enter the freighting business. Spratt & Gray are fitting her with machinery, and Shaw's Iron Works will supply her boiler.

Murray & Munroe, Pembroke, Ont., have completed the new wharf at L'Orignal, Ont.

The Richelieu & Ontario Navigation Company has declared a semi-annual dividend of 3 per cent.

The C.P.R. is arranging for the construction of a $6,000 dock at Kaslo, B.C, similar to the one at Nelson.

The steamers "New York" and "Empire State" will supply a daily service down the St. Lawrence rapids this summer, running from Clayton to Montreal. The Folgers of Kingston are the proprietors of the line.

A. J. Harvey & Co., St. John's, Newfoundland, have bought the steamer "Lucerne" from the Allans, to carry pulp and general freight from Newfoundland to England. Capt. D. Taylor has been appointed to the command.

James Playfair & Company's tug, the "Magnolia," was launched at Midland, May 24th. She is 140 feet long, 21 feet 6 inches beam, and will draw, coaled, fourteen feet of water. She will be used principally for towing and wrecking.

The earth under the River St. siding and the coal docks, Owen Sound, slid into the river recently, allowing both to sink about five feet for a distance of over two hundred feet. Dredging the harbor is supposed to be responsible for the slide.

The Furness line will formally take over the business of the Canada and Newfoundland Steamship Co., which it has bought, on July 1st. The four men who owned these boats were: David McPherson, W. Barry, P. Pierson, and S. M. Brookfield.

Two new passenger steamers of the Dominion Line will be on the St. Lawrence route from Montreal this season, viz., the "Dominion," a fine twin screw steel ship of 6,000 tons, equal to the "Canada" in finish, and the "Yorkshire," also new and of similar construction and equipment.

Captain Thomas Howard, the late harbor master of Montreal, who died recently, was well known and much respected in commercial circles in Montreal, where he had been a resident fifty-six years. He was born at Shinrone, Queen's County, Ireland, on Sept. 15th, 1826, and came to Canada in 1842. For a time after his arrival he was in the employ of the late Hon. John Hamilton, and later entered the service of the Richelieu & Ontario Navigation Company. For some years he commanded the "Banshee," "St. Lawrence," "Magnet" and other vessels of the company plying between Montreal, western ports and the Saguenay, and was subsequently appointed manager of the Ontario division of the company. In March, 1881, he was appointed harbor master. He had thus been connected with the business of the port for nearly half a century.

A large deputation from Kingston, Prescott and Deseronto, waited upon the Minister of Marine and Fisheries recently, to request that the department should make an order suspending the regulations for this year, which require American passenger steamers to comply with the same regulations as Canadian passenger steamers. The Canadian inspection requirements are not the same as American, differing particularly with respect to life preservers and the inspection of boilers. It has been the custom in the past to accept the American inspection, but an amendment to the Canadian Act requires conformity to the Canadian regulations. The deputation comprised delegates from Kingston and other towns and was accompanied by the following members of parliament: Messrs. Britton, Charlton, McGregor, Frost, Hurley, Edwards and Snetsinger. The Minister promised to give the request a favorable consideration if possible.

The Manchester Liners, Limited, is formed to acquire and run three steamers between Manchester and Montreal in summer, and St. John, N.B., in winter. These steamers are to cost £90,000 each, are to steam twelve knots an hour, and to have a carrying capacity of 8,500 tons. One is to be ready in August and two in the spring of next year. But two steamers are to be immediately acquired for the work, so that the approaching autumn and winter will now be amply provided for. There is no question of the extent of the traffic available, and we share the confidence of the directors that the new service will have remunerative results. The authorized capital is £1,000,000 in shares of £10. Sir Christopher Furness is chairman of the company, and his experience is security that the company's business will be conducted with intelligence as well as vigor.

The Pembroke Navigation Company has launched the new vessel recently built for them in Toronto by the Polson Company. She is built of iron and is 125 feet in length, with a twenty five foot beam, and is capable of attaining eighteen miles an hour. The cost was $30,000.

The Donnelly Wrecking Company of Kingston have purchased the sidewheel steamer "Columbia," which ran ashore at Sarnia last summer. She will be put on the government dry dock at Kingston. The "Columbia" was formerly worth $10,000.

Mr. O. E. Young, of Magog, is building a small pleasure boat for Mr. L. B. Ward, of Brooklyn, N.Y., to be used on Lake Memphremagog, and an order has been placed with the Jenckes Machine Co., of Sherbrooke, Que., for one of their 7 h.p. Dake marine engines, with boiler to run the same.

The two steamers for the Dominion Atlantic Railway Company, being built on the Humber, England, are the "Prince George," which will reach this country about the middle of June, and the "Prince Arthur," which will come a fortnight later. Both steamers are alike. They are 300 feet long, 38 feet beam, 15 feet draught and 6,500 h.p. They have a speed of 21½ knots on the measured mile and are guaranteed 19½ knots at sea in any weather. Each engine has four sets of cranks instead of the usual three. All the heating will be done by electricity and they will have electric fans.

An announcement of some commercial interest to Canada is to the effect that the enlargement work on the Erie canal will have to be suspended for at least two years. Through some miscalculation or mismanagement the nine millions voted for the work has been expended, and the waterway is available for no larger craft than have navigated it for years past. It will take two years, under the law, it seems, to obtain authorization for a further loan, and some time more to complete the enlargement operations. Meantime, if the present programme is carried out, next season will see the enlarged St. Lawrence canals available, and Canada will have at least a year's start of New York in the use of the improved waterways.

The Polson Iron Works, Toronto, have just shipped a steamer, which will be the first to reach the Yukon, intact from this port. The boat started from here to Vancouver on two C.P.R. flat cars, whence it will be forwarded on an ocean steamer to the Yukon—an exploration boat, built for either day or night service, and to accommodate four mining engineers and crew. She is called the "Burpee," after her purchaser, and is, length on water-line 45 feet, over all 53 feet, beam 9 feet, draught of water 10 inches. She was designed by W. E. Redway, is built with a steel frame and wood planking, with boiler and engine aboard ready for immediate service on reaching her destination. Her speed will be about 10 to 12 miles; cost, $6,000.

Railway Matters.

The C.P.R. will build a new station at Almonte, Ont., this year, it is expected.

The management of the G.T.R has decided to construct 250 refrigerator cars for the general service of the system.

There are at present 200 men at work in the Perth, Ont., car shops of the C.P.R., and work is continued each night up till midnight.

Dutton, Ont., has defeated the by-law granting a bonus to the L.E. & D.R.R. in aid of the extension from Ridgetown to St. Thomas.

The bill of the Ottawa, Montreal and James Bay Railway Co., was passed by the Dominion Government recently. The intention is to build north from Labelle, about 100 miles north of Montreal, and to continue to the shores of Rupert's Bay, a distance of 375 miles.

It is stated that Louis Coste, chief engineer of the Dominion Public Works Department, has pronounced against the Mackenzie-Mann Teslin Lake Railway scheme, and that it was on account of this hostile report of the government's own engineer that Sir Wilfrid Laurier telegraphed to British Columbia that the ministry could not support the scheme.

The Ottawa and New York Railway Co. has offered to build its workshops in Ottawa if it is given a bonus of $100,000.

The case of Hannaford v. Grand Trunk is postponed for some time, because it has been decided to appoint a commission rogatoire to take the evidence of Sir Charles Rivers-Wilson and Messrs. L. J. Sargeant and Linley, the commission being returnable on June 18th. Charles Russell, son of the Lord Chief Justice, will act as the commissioner.

The city of Montreal has offered a free site for an office building for the G.T.R., and the Grand Trunk has accepted the gift. This finally disposes of Toronto's fancied prospect of securing the office. The terms upon which the site will be given, are as follows: That the company be offered part of the McGill street property, owned by the city, as follows: 199.4 feet on McGill street, and 135 feet on St. Paul and William streets, respectively; the building to cost not less than $250,000, the assessment to be levied on that amount only for a period of twenty years, this latter arrangement to be submitted to the legislature for ratification. The plans of the proposed building to be submitted to the city for approval.

Sixteen "Mogul" engines have been purchased by the C.A. & O.A. & P.S. Railways for the freight business. The engines are much larger than the ordinary passenger locomotives. Compared with the new engines the old ones look quite small. Ten of these new engines are of the ten-wheel "Mogul" type and each weighs 156,000 pounds without the tenders. They have three couple-wheel drivers and are equipped with compound cylinders. The other six engines are of what is known as the consolidated type of "Mogul." They are equipped with four couple-wheel drivers, and have compound cylinders. They weigh 173,000 pounds exclusive of tenders. The engines will be used exclusively for freight.

It would seem that the C.P.R. has definitely decided to push forward a line from Toronto to Sudbury at once. Two corps of surveyors are already at work in charge of H. D. Lumsden, who surveyed the Crow's Nest Pass road. One party will spend the entire summer in the Nipissing district, and another party will start out from Coldwater and survey southward through Barrie to the Orangeville branch of the G.T.R. at Kleinburg or Bolton. The new line will take the shortest cut between Parry Sound and Sudbury, and will extend inland so as to open up the Nipissing and Parry Sound districts. From Parry Sound the road will extend southwards to the west of Muskoka lakes, and across the Muskoka river at Bala, thence to Muskoka wharf and south-west across the Severn river to tap the Midland branch of the G.T.R. at Coldwater. The new line will save 55 miles haulage between Toronto and Winnipeg, and will be completed in about two years.

The British Columbia Government has passed a railway aid bill, which provides $4,000 per mile for the following railways: From Penticton to Boundary Creek, 100 miles; from Robson to Boundary Creek, 80 miles; from the Pacific coast to Penticton, 230 miles; from Bute Inlet to Quesnell, 230 miles; from Teslin Lake to a British Columbia seaport, not exceeding 400 miles. The act provides for the commencement of the Penticton-Boundary and Robson-Boundary lines on or before the 8th of August, 1898, and on the coast to Penticton and Bute Inlet to Quesnelle on or before the 8th day of May, 1898, work to commence on the Yukon line on or before the 8th day of June, 1898. The bill further stipulates in the case of the line from Robson to Boundary being built by a company entitled to a land grant, that such company shall relinquish its claim to the land grant for such portion of its line on accepting cash subsidy. It was expected that McKenzie & Mann would build this line but they have notified the British Columbia Government that they cannot carry out the work.

Bystander, in the St. John's, Que., News, commenting on the Hannaford v. G.T.R. case, and contrasting the old regime of that railway with the new, says: "Mr. Hays is down at his work at nine o'clock in the morning. He generally walks to the Point, but, if in a great hurry, he will permit himself the luxury of a street car. This may seem a trifle in a man who can think as clearly at ten as at nine o'clock, but it has worked a revolution in the Grand Trunk system. Punctuality is understood for the first time in the history of the company. Duty means enthusiastic and earnest and unflagging work. Nepotism has been taken by the shoulders and bundled out of the thought of the new management. The sole test is merit. The humblest person has as much chance of preferment as the nephew of the president. Mr. Hays is a direct, simple, democratic personality, and every officer under him is accessible to the public at all times. The new manager would be vastly surprised to see one of his officials coming down to his office in his carriage at eleven o'clock in the day, as was the case under the old regime.

Electric Flashes.

Belleville, Ont., Street Railway is to be extended to a park on the lake shore.

Free power is obtained from the Canada Coal and Railway Company to run the electric light plant at Joggins, N.S.

Bonuses are being sought for the proposed electric road from London, through Stratford, Arkona and Thedford, connecting the Canadian Pacific with the Grand Trunk.

S. H. Kent, secretary of the Hamilton, Ont., Committee on Municipal Lighting, is carrying on an extensive correspondence in pursuit of information regarding civic electric lighting in other municipalities.

Simeon H. White, Andrew L. Price, C. Geo. Armstrong, Walter J. Mills and Hamilton B. Price, Sussex, N.B., have applied for a New Brunswick charter as The Little Salmon River Telephone Company, Limited, capital $1,500.

The by-law authorizing the agreement with the Montreal Street Railway Company was voted on at Verdun recently, when eighty-three proprietors voted in an approval of an immediate street railway service, and only six voted contrary. The by-law was therefore affirmed.

At the annual meeting of the Quebec Electric Street Railway Company, Andrew Thomson was elected president; E. W. Methot, vice-president; and W. Shaw, Jno. Breakey, Judge Chauveau, E. E. Webb and Harold Kennedy, directors for the current year.

A company from Bellechasse has asked for Quebec letters patent under the name of the Ste. Philomene Telephone Company. It will place telephones in the counties of Bellechasse, Montmagny and Dorchester, with headquarters at St. Raphael, and a capital of $1,500.

The Toronto City Council is engaged in a dispute with the Electric Light Company, the result of an effort on the city's part to compel the company to light the Island, which is within the city limit, at the city rate of 20¼ cents per lamp per night.

The contract for covering the pipes and boilers in the power house of the St. John Railway Co., St. John, N.B., has been completed by the Eureka Mineral Wool and Asbestos Co., Toronto. This company has had several large covering contracts of late, not a few of which were repeat orders.

The Niagara Falls, Ont., Electric Light Company has purchased machinery from the Westinghouse Company, to provide electricity for heating and power purposes, in addition to the present lighting system. The changes that will be made at their power house, and wiring of streets, etc., will involve an expenditure of about $10,000. They will be able to supply from one to seventy-five horse-power 24 hour service.

The plant of the Acetylene Light, Heat and Power Company, known as the Carbide works, at Niagara Falls, N.Y., was sold under chattel mortgage proceedings a short time ago. The action was brought by the Electro Gas Company, of New York, who held the mortgages, and the plant, machinery and power rights were bought by them for about $85,000. The Electro Gas Company will continue the business.

The Kingston Street Railway has about completed a branch line to the outer G.T.R. station on Montreal Street, going by way of Bagot and Montreal streets. It will be in operation early this month. The line will be in competition with the Grand Trunk Railway, which has reduced fares to five cents per trip. It is expected that much of Princess Street will be double-tracked and a belt line made on the northerly side of the city by way of Division, Pine and Montreal streets.

A dynamo and a number of lamps have been supplied by the Royal Electric Company to the Soulanges Canal.

Wood Bros., Brantford, Ont., have recently bought from the Royal Electric Company a 70 h.p. synchronous motor.

The Montmorency Power Company, Quebec, has bought a 600 K.W. "S.K.C." generator from the Royal Electric Company.

C. E. Campbell, Weymouth, N.S., has been supplied with a direct-connected lighting plant by the Royal Electric Company.

A 300 K.W. "S.K.C." synchronous motor has been bought from the Royal Electric Company by the Golden Cache Mining Co., B.C.

The contract for building the Canadian branch of the Carborundum Works, Niagara Falls, Ont., has been secured by James Harrison. The structure will be frame 30 x 60 feet.

The B. C. Bullion Extracting Co. has made a contract with the Canadian General Electric Co. to supply a 100 horse-power synchronising motor, and a 50 horse-power induction motor for their works, which are about a mile and a half from Rossland, B.C.

John Forman, importer of electrical supplies, 644 Craig street, Montreal, has recently issued catalogue "B," which contains a great deal of useful information for all users of electrical apparatus of any kind. Edison lamp, Ericsson telephones, Anchor switches, and a great many other standard appliances, as well as numerous novelties, are always carried in stock.

J. R. Scott, an enterprising citizen of Napanee, has closed a contract with the Canadian General Electric Co. for a 100 K.W., 4,000-volt three-phase generator of the revolving field type, for the purpose of supplying light and power to Napanee from a water-power eight miles distant. He will also supply light and power to intermediate points such as Napanee Mills, Camden East, and Newburgh.

A meeting was held at the Halifax Hotel, Halifax, N.S., April 12th, 1898, at 3 p.m., for the purpose of organizing an association of all those interested in the electrical industries in the Maritime Provinces. The following gentlemen were present: John Starr, C. E. Harris, Jas. Waddell, N. L. Ross, J. H. Winfield, L. A. Somers, J. D. Briggs, P. Mosher, A. Miller, John Griffin, J. A. Anderson, P. R. Colpitt, F. A. Bowman, E. T. Freeman, I. H. Smith.

The West Kootenay Power and Light Co. is rapidly completing its power plant at Bennington Falls. The poles are set and two wires are stretched between the falls and Rossland, a distance of 31 miles. The line goes into Rossland over the Monte Cristo Mountain, and it is the intention of the company to stretch another wire so that in case of accident there will be no interruption of the current. The first cost of the plant is placed at $125.000, but it is said that the expenditure upon it may be extended to half a million.

A Dominion charter has been granted to the North Shore Electric Railway Company, the applicants being: Wm. Owens, Westmount; V. W. Larue, Quebec; Wm. Strachan, R. Prefontaine, Thos. Gauthier, and Albert J. Corriveau, Montreal. Mr. Corriveau says that it is intended to use power generator at the Shawenegan Falls. The railway is to start at Three Rivers, and general powers are given for the counties on the north shore of the St. Lawrence. Privileges are conferred similar to those granted to Montreal and Southern Counties Railway Company.

E. A. C. Pew's project to produce water power by the construction of a channel from the river Welland, east of Wellandport, to the river Jordan, although remaining in abeyance for some time past is coming to the front again. The works will be gone on with if satisfactory contracts can be made for disposing of the power when generated. Wm. Pearson, C.E., Oswego, has, it is said, pronounced the scheme a feasible, safe and practical one, pointing out that the great source of expenditure in connection with the development of power at Niagara Falls—the construction of wheel pits and tail race—will not be necessary in this project. The principal expense will be the excavation.

Barrie, Ont., is advertising for tenders on an electrical installation to consist of a street lighting plant of 65 arc lamps of 2,000 candle power, an alternating current plant to supply 2,500 incandescent lamps for private lighting, and a direct current 500-volt power plant to furnish cheap electrical motive power to manufacturing establishments. An up-to-date electrical fire alarm system will also be installed. The estimated cost of the entire equipment is placed at $35,000, and as quality of machinery and apparatus will be made a first consideration before prices, the town will, no doubt, obtain a very complete and high-class installation. Tenders will be opened on June 6th next, but the awards will not be made before the ratepayers have voted the necessary moneys. Roderick J. Parke, of Montreal, is the consulting engineer for Barrie.

The C.P.R. copper telegraph line, from Montreal to Vancouver, is now building. The line passes via Vaudreuil and the Short Line to Ottawa, and thence by the main line to the coast. It will be strung under the general superintendency of W. J. Camp, the C.P.R. electrician, in three divisions. The first one will reach from Montreal to Fort William, and will be conducted by Jos. Townsley, with about 100 men, working simultaneously in four gangs. The next division will reach from Fort William to Donald, B.C., and will be under B. S. Jenkins, Supt. of Telegraph, Winnipeg, with three gangs of men. The final division will reach from Donald to the coast, and will be under the charge of J. Wilson, Supt. Telegraph. A great deal of trouble has been experienced by telegraphic companies, through wires coming in contact with each other, through the breaking of the glass insulators by which the wires are attached to the poles. A test was therefore made at McGill University with a view to ascertaining the comparative resistancy of glass and porcelain insulators, with the result that it was found that porcelain resisted much heavier, and a greater number of blows, than the glass. Tests were also made with a thirty-two calibre revolver from a distance of eight feet. The glass flew to pieces at nearly every shot, while the porcelain frequently showed no mark, save the lead from the bullet, and when they did break it was in such a way that, had they been attached to the pole, the wires would not have been affected. The testing of the wire is also going on at the Applied Science Department of McGill, under the care of Mr. Drinkwater. Each day he selects at random a sample of wire from each lot of ten bundles being turned out by the Dominion Wire Mfg. Co., and subjects them to tests in order to insure that they come up to the requirements of the contract. The wire must be .137 of an inch in diameter; one one-thousandth of an inch only of a variation being allowed above or below this gauge. It must be perfectly cylindrical and weigh 300 pounds to the mile; four pounds of a variation being allowed in this distance. Frequent electrical tests are made upon pieces one one-hundredth of a mile in length, to determine the purity of copper used, which must be 97 per cent. Each bundle weighs 170 pounds, and the wire must be in one continuous length, without joint or break. Each six inches of wire must be capable of being twisted thirty times at a uniform speed of one twist a second. The tests show that it will stand forty to fifty twists before breaking. It must stand six close turns around another wire of equal diameter and be unwound without breaking. It must also stand an average breaking strain of 975 pounds, and before breaking it must have stretched at least one per cent. When completed there will be a length of about 2,900 miles of wire.

Personal.

H. M. Bolger, secretary of the Richelieu and Ontario Navigation Co., Montreal, was married a short time ago to Miss Mills, of Quebec.

P. Kennedy, employed in the C.P.R. car shops, Perth, Ont., had his head crushed between two cars, and was instantly killed, May 13th.

R. G. McConnell, of the Dominion Geological Survey, and J. B. Tyrell have left for the Yukon, and will spend the entire season in that district.

H. C. Landon, C.E., Cornwall, Ont., has removed to Austen, Pa., where he will have charge of a section of the Buffalo and Susquehana Railroad.

Frederic Nicholls, managing director of the Canadian General Electric Co., sailed on the "Campana" recently for a visit to England and the continent

Alexander Milloy, after fifty years of service in the Richelieu and Ontario Navigation Company, acting as traffic manager, has retired. G. A. Browne will be his successor.

Wallace Bell, the well-known well sinker, Montreal, has gone to Newfoundland, where he has been asked to help in developing the newly discovered oil regions in the island.

D. J. McDonald, British Columbia inspector of mines, has resigned his position to enter the service of the British America Corporation, under W. A. Carlyle, late provincial mineralogist.

Wm. Bunney, who has been for the past six years in the employ of the Wm. Cane & Sons Mfg. Co., Newmarket, Ont., as foreman, has taken a situation with W. C. Edwards & Co., Ottawa.

Samuel Lyons, head engineer of the Stewiacke, N.S., foundry, was instantly killed a short time ago. He was working at the emery wheel, when it suddenly broke, a portion of it striking him violently over the heart.

O. H. Sheppard has accepted the position of cashier of the Toronto Ferry Company, made vacant by the resignation of Walter Garwood, who has been appointed to a more lucrative position with the Queen City Oil Company, Toronto.

Mr. D.A. Starr, president and manager of the Cornwall Electric Street Railway Co., was waited upon by a deputation of the employees and presented with a handsome gold headed cane, with many good wishes, on the occasion of his birthday a short time ago.

News reached Montreal last month from Liverpool, of the drowning of a well known Canadian Pacific official, T. F. B. Evans, who was agent at Liverpool for the company for the past ten years. Mr. Evans while boating off Bangor, Wales, where he was enjoying a short holiday, fell out of his boat and was drowned.

W. J. Carroll, St. Catharines, Ont., who has been engaged in engineering work upon the Crow's Nest Pass Railway since last September, has received an appointment as chief engineer of the Sindicate Industriel de Sud America, a company formed to build a railroad from Quito to Pailon, on the west coast of South America. The district about Pailon is famous for its rich gold deposits. The company receives from the Government a concession of about seventeen million acres of land.

W. Robert, cashier of the Richelieu and Ontario Navigation Company, received a handsome present and illuminated address a short time ago. The presentation was made by C. F. Gildersleeve, the general manager, representing the staff of officials, and the occasion was the severance of the connections between Mr. Robert and the company. Mr. Robert will shortly leave for Quebec, to fill the position of paying teller in the new branch of the Hochelaga Bank, about to be opened in that city.

Robert N. Stevens, mechanical superintendent of the I.C.R. at Truro, N.S., died at his home there May 18th. He was about 64 years of age, and was well and favorably known both in New Brunswick and Nova Scotia. He has been identified with the I.C.R. ever since it was opened and was engineer of the first train over the road, going as far as Coldbrook. He rose in the service, and was for years mechanical superintendent at Moncton. During the past three or four years he has been mechanical superintendent at Truro.

Milton L. Hersey, the well-known chemical expert and assayer, on whom the degree of Master of Applied Science has been conferred by McGill University, is the youngest son of Randolf Hersey, Montreal. His primary education was by private tuition, and he soon entered the Royal Arthur School, from which he was promoted in 1881 to the Montreal High School. From the latter he graduated in 1885, entering the Department of Applied Science of McGill University the same year. Mr. Hersey graduated from McGill nine years ago as Bachelor of Applied Science and has since then held some very important positions, during a portion of the time being connected with the teaching staff of the University. He spent most of the years 1889 and 1890 studying and traveling in Europe and the United States, and on his return to Canada in 1891, he was appointed chemist of the Canadian Pacific Railway. From this position he resigned in 1896 to take up the general commercial chemistry and assaying, but still remains the consulting chemist of the Canadian Pacific Railway.

F. C. ARMSTRONG.

The Canadian General Electric Company is about to lose an important member of its agency staff in the person of F. C. Armstrong, who has resigned his position of general agent for that company to take up similar work with Dick, Kerr & Co., Limited, London, Eng., well known as a large engineering and contracting firm throughout Europe and the British Empire. Mr. Armstrong is a Canadian by birth. He commenced his education at Peterboro, Ont., with Dr. Tassie, and afterwards graduated from Toronto University. After leaving the university, in 1889, he engaged in electrical work and spent three years of those pioneer days as an electrical and engineering contractor. Since 1892 he has been in the employ of the Canadian General Electric Company, as chief of the agency staff, and during this time not only has he become favorably known to the public, but has obtained a broad technical and commercial knowledge, which no doubt will be of immense benefit to him in his new and larger sphere Mr. Armstrong has prepared at different times several papers for the meeting of the Electrical Association, and has also materially added to its success by his efforts as a member of the Executive Committee. While Mr. Armstrong's departure is to be regretted as being a loss to the country, yet he must be congratulated on the recognition of his marked ability and promotion to the important position which he will hold with Dick, Kerr & Co.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A. ROSS, E.E., M. CAN. SOC. C.E.

The subject of electric power transmissions over long distances has for the last few years been the field in which the most prominent electrical engineers have found a scope for their energies, and the advance in consequence has been most marked. So much so that, while four years ago there was not a power scheme of any magnitude, at the present they are numbered by the score, and are of such size as to utilize an immense amount of power formerly unavailable. A noteworthy point in modern plants is the similarity of the methods in use, especially in America, which is always more given to standardization than are European countries. The several types of alternating transmission have practically crystallized into two standard forms remarkably alike in detail and equally applicable to most cases. The controversies over the relative merits of direct and alternating current for transmission purposes have been settled, and the latter having come out victorious is now carrying the war into the hitherto undisputed territory of the former, namely, the application to general motor purposes, and the results are not doubtful. With the application of alternating current motors to traction purposes, which appears to be not far distant, the last territory held exclusively by the direct current will have been invaded. The reason for this state of things is not far to seek, as the alternating system which formerly was applicable only to incandescent light, has recently made such strides as to prove itself more generally useful for all purposes of transmission and for most cases of distribution than the other. This triumph of the alternating is due to the fact that with extremely simple and durable apparatus, the power is so readily transformed into that form which meets the requirements of most cases.

The efficiency and durability of the newer types of apparatus are such as to leave but scant room for improvement, and it appears probable that unless some fundamental discovery is made, which will render present types entirely obsolete, these forms will persist for some time to come. Accompanying this standardization of apparatus has come a remarkable decrease in first cost and maintenance charges affecting the interest and depreciation accounts correspondingly, and resulting in decreased cost of power to the consumer. In consequence we may expect to see the field of steam generation for many purposes invaded by the simpler, cheaper and more cleanly electric power. If we may judge by present indications, the next phase of the problem to be attacked will be the adaptation for railway purposes of power for large water falls. This only awaits the development of a satisfactory motor for alternating traction purposes, and, from the reports of several recent installations in Europe and the statements of prominent traction engineers in this country, the day of the alternating railway motor for use on the longer railways is not far distant.

To illustrate the methods adopted in transmission work, a few of the larger plants in operation or building are given below.

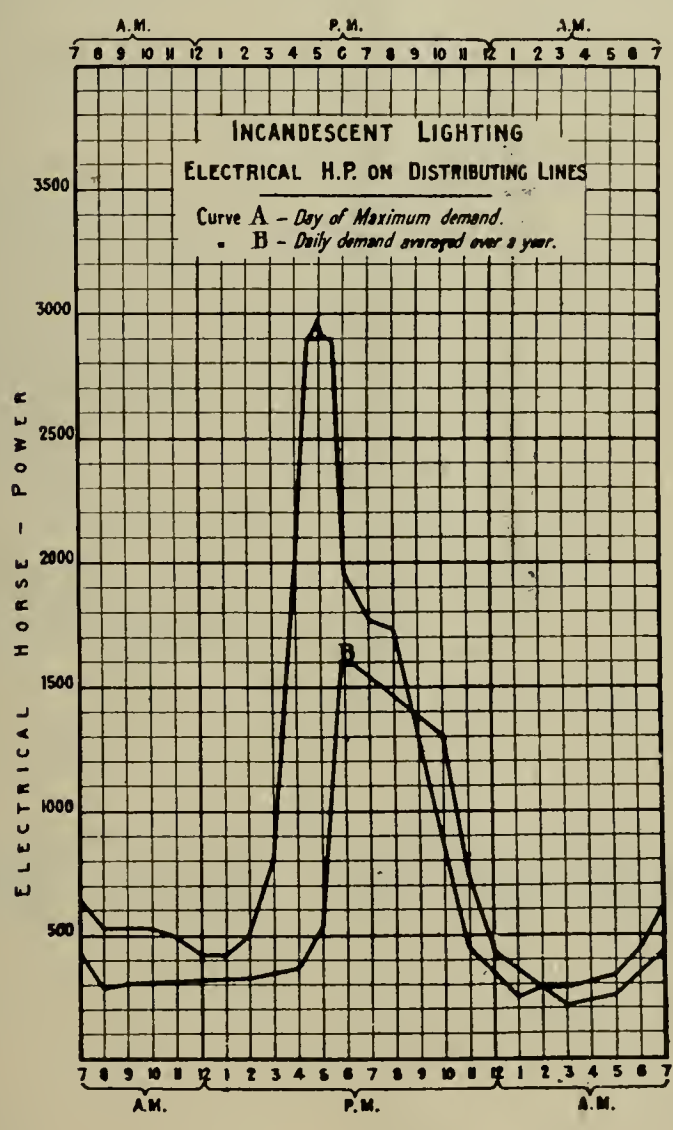
	System.	Distance.	Voltage.	Horse-power.
Brescia,	Direct cur.	12	15,000	700
Pomona,	Single phase.	29	10,000	800
Fresno,	Three phase.	35	11,000	1,400

*From a paper read before the Canadian Society of Civil Engineers.

Lauffen,	Three phase.	100	30,000	300	Experi-[mental
Portland	" "	12	6,000	5,000	
Ogden,	" "	38	16,000	3,000	
Three Rivers,	Two phase.	17	12,000	600	
Kootenay,	Three phase.		20,000	2,000	Building.
Hamilton,	Two phase.	38	20,000	3,000	"
Lachine,	Three phase.	5	4,400	20,000	
Chambly,	Two phase.	16	12,500	20,000	Building.

With one exception these are all alternating plants, and it will be noticed that Canada is well to the fore, as might be expected from the almost unlimited powers available. Montreal stands at the head of the world so far as transmitted power is concerned, and it appears probable that the two magnificent schemes at present under construction will find an ample market in the city and vicinity. Montreal's demands, covering as they do the whole field of consumption of power for street railway, incandescent and arc lighting, and motor power, offer a good example for illustrative purposes, and it has been deemed advisable to give point to the discussion to follow by reference to the demands existing in that city at the present time, without reference to future necessities, as these will no doubt be much of the same kind.

With this end in view, the following curves have been drawn, showing the demands for all classes of power at the present time for twenty-four hours.



The higher curve in each case shows the maximum demand during the year, and the lower the average load at each hour of the day for the year. From these demands the transmission scheme will be figured, but necessarily in a general way for illustrative purposes. The problem consists in laying down the power in the city to suit the demands in the most complete way as regards economy, efficiency and suitability. As these demands affect the transmission by their nature, as well as by their amount, they must be considered briefly before taking up the transmission proper.

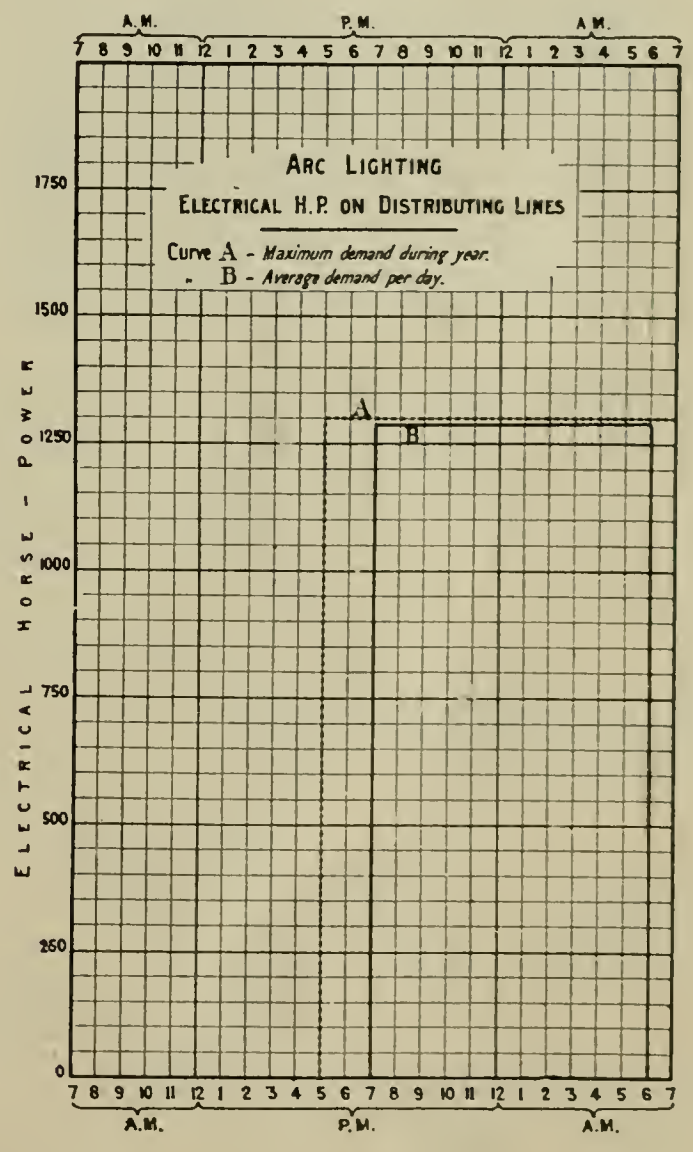
Incandescent Lighting.—The demand curves shown have been figured from the actual curves of one of the present stations in the city, with an allowance for the loads of the other operating companies; in all to cover 100,000 lights wired up. To meet this demand it will be readily granted that direct current is unsuitable, owing to the distances to be covered, and alternating currents of single, two or three phase are the only alternative, any of these being readily obtained from the transmission voltage by means of static transformers to feed the distribution at a voltage of say 2,000, which is considered safe for city work. This potential will of course be again reduced before entering customers' premises, thus involving two sets of transformers. This system will also cover interior lighting by alternating arc lamps, and perhaps a few small alternating motors.

The demand curves for the arc lighting have been figured on the supposition that there are 2,000 arc lamps on series circuits in the city, lighted from dusk to dawn, the curves in this case being elevated into straight lines. For this service several plans present themselves as below.

(1.) By rectifying the alternating transmission currents into direct through the agency of rectifiers, which are simply revolving commutators driven by small synchronous motors from the transmission line, and using this current in the present series arc lamp. This system has been in use for a short time in several European stations, with varying results. It appears to have a great future before it when it has come through the present doubtful stage.

(2.) By means of alternating arc lamps fed from the incandescent circuits. This system, while perfectly applicable for interior lighting, where each unit is treated as an incandescent lamp and turned on or off at will, is not so suitable for street lighting, as it does not lend itself to ready control from the station. Further, as the light distribution of alternating current lamps is inferior per watt of consumption to that of direct, it becomes more expensive in operation.

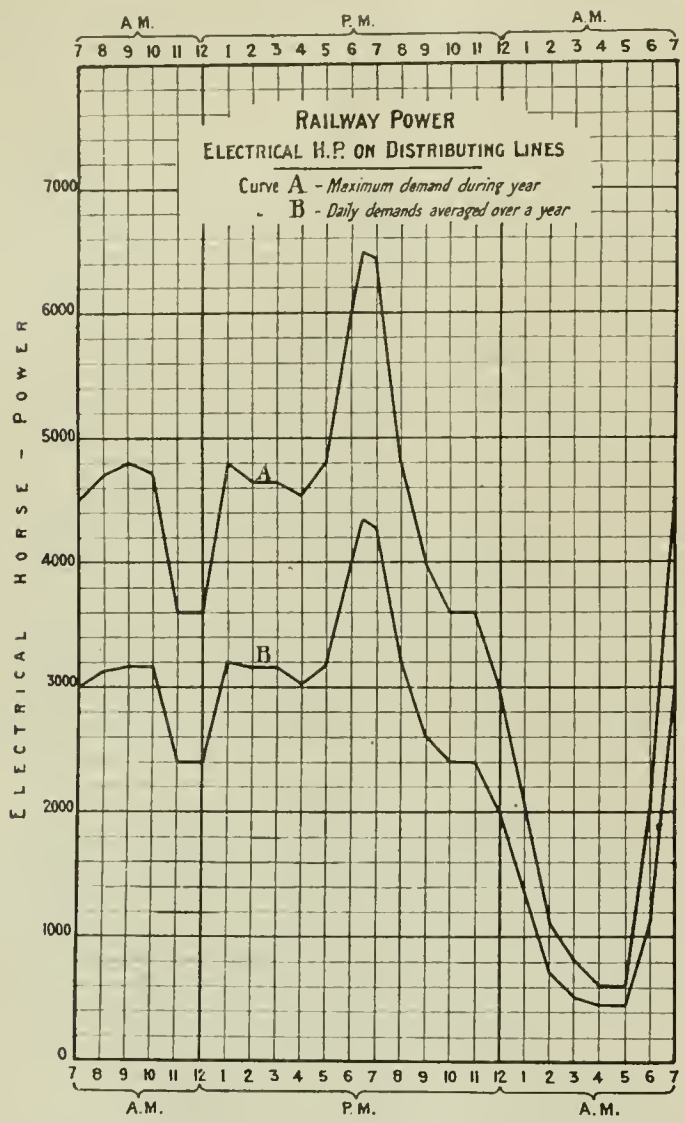
(3.) The series arc system as at present used, with motors instead of engines to drive the dynamos, while necessitating more apparatus than either of the others, is more simple and controllable in operation, and will be accepted for illustration. The number of units necessary to cover the 2,000 lights will be 16 if of 125 lights each, which is about as high as is available per machine. If these were coupled in pairs to 200 H. P. motors, the units would be eight, and the addition of a spare would make a total of nine, which would be ample for present demands.



Either alternating or direct current motors are suitable for general work, but, where variable speeds are necessary as for elevator purposes, the direct is at the present time the only one available. The cost of the former is also higher at the present time. The advantages of the alternating motor distribution are, less cost of circuits, greater simplicity of apparatus, and the ability of reaching outlying demands at small cost, and that it involves no special apparatus in the distributing station other than the necessary lowering transformers. As the objections to

the alternating (on the score of price and unsuitability where speed regulation is required) appear to be within reach of correction in the near future, that method will be adopted for this case. The demand curves are based upon the actual load curves of one of the present stations, with allowance for the other operating companies' loads. In all it represents about 1,100 H.P. of motors installed, to be driven from a two or three phase motor circuit, fed directly through reducing transformers from the transmission line, at a voltage of say 2,000, and again reduced by individual transformers at the motors.

The curves shown in the accompanying figure are the actual records for the past year for the railway company's plant. As at the present time only direct current motors are applicable to this purpose, means must be adopted for transforming the alternating to direct current for the trolley circuit. This is easily



accomplished by means of rotary transformers with small loss. These rotaries are practically direct current generators, with collector rings through which the alternating current flows to the windings driving the machine as a motor, while from the commutator connected to the same windings the direct current, which has been commutated from the alternating, flows to the trolley line.

(*Continued in next issue*)

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—In the course of a recent address upon building stones by Prof. Julien, of Columbia College, New York, before the Mineralogica Section of the Franklin Institute, some interesting facts were brought out. Professor Julien is an authority on building stones, and an expert in the preparation of thin sections of rocks—sections so thin that they are transparent; and their structure can thus be readily seen under the microscope. On this occasion the thin sections were placed in an electric projecting microscope, and the enormously magnified images were thrown upon a screen. The light was polarized by interposing suitable prisms, and under these circumstances each particle composing the stone revealed itself by its shape and color. The mechanical structure, porosity, density, etc., of each variety of stone were shown, revealing the way in which aggregations of rock particles are sometimes loosely held together without orderly arrangement and with spaces between, sometimes dovetailed into each other, and sometimes cemented together into a homogeneous mass. In some of the sections, which were as thin as a sheet of tissue paper, bubbles of liquefied carbonic acid gas were observed in the cavities of the small crystals. This liquid is held in the stone under pressure, and not infrequently the heat of the electric light, or even of the hand, is sufficient to explode it, shattering the specimens. It was easy to perceive from these illustrations why some building stones will stand great compressive strains and may yet be unsuitable for buildings in these latitudes, while other stones, much weaker inherently, may possess greatly superior weathering qualities. The statement was made that no "weathering tests" of building stones worthy of the name have yet been made. It seems very necessary that this should be done.

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STREET PAVING MATERIALS.

BY J. J. BELL.

It is clear that the experimental stage has not yet been passed in determining what is the best material for street paving. So many points have to be considered—durability, facility of repair, noise, sanitation, cost, etc., that it is difficult to determine what material combines these qualities in the greatest degree. What is suitable for one kind of traffic may be unsuitable for another, what is a success in one climate may be totally unfitted for another, a cost which is possible on a great business thoroughfare, or a fashionable residential street, may be out of the question on the poorer streets, where property owners cannot afford an expensive pavement. A good deal has yet to be done in the way of experiment, and the material employed must vary according to local conditions.

Wood and stone are the two natural materials which suggest themselves for street paving. The noise produced by traffic over a stone pavement precludes its use on residential streets, except in the form of macadam, while wood, so far as used hitherto in this country, is not sufficiently durable for heavy traffic. There is, however, a growing tendency to go back to wood in European cities, especially Berlin, and it is said that before long three-fourths of London will be surfaced with this material. The wood employed there is the Australian jarrah, which has displaced all kinds of wood except Baltic fir, which it is rapidly driving out. Jarrah is an exceedingly hard wood and is said to be equal in wear to granite. It is impervious to moisture, and being a species of eucalyptus is antiseptic and therefore no objection can be urged to its use on sanitary grounds. Another Australian wood, karri, is second only to jarrah, and the Tasmanian blue gum has stood very satisfactory tests in Glasgow. Of course none of these woods are likely to come into use in America, as it would cost too much to import them, where other suitable material is so abundant.

The experience of cities on this continent seems to point to asphalt as the best all-round paving material, cost being the principal objection. Laid on concrete it is durable, clean and easily repaired, and heavy traffic seems to harden and consolidate it. It is liable to rot from water lying on it, but this may be overcome by giving the roadway sufficient crown to allow the water to run off freely and by substituting stone or other material for gutters next to the curb. Asphalt will not answer for track allowances or the strip close to the rails, where the jarring of the cars rapidly disintegrates it, but with granite blocks, or better still, so far as bicycle traffic is concerned, scoria or brick on the tracks, asphalt makes an almost ideal street. An objection is the tendency of horses or bicycles to slip. With a thin coating of ice or snow, or in muddy weather, they are liable to do so, but there are comparatively few days in the year when such conditions exist to an extent to cause inconvenience. An interesting test of the merits of different pavements for slip was made in London, England, some time ago, when a record of the accidents for 50 days showed asphalt 1,066, granite 719, wood 542. On streets of steep grade asphalt cannot be employed. In Halifax concrete is used on grades and asphalt on the level. In New York asphalt is being substituted for granite on some of the streets, the asphalt surface being laid over the granite just as it is, instead of removing it and putting down concrete foundations.

So far as sanitation is concerned, an interesting fact is stated with regard to Buffalo, N.Y., which has more asphalt pavement than any city in the world. It is asserted that since the introduction of asphalt the death rate has decreased, especially among children. This, if verified by the experience of other cities, should go far to encourage the use of asphalt.

Next to asphalt in favor as a permanent paving material, and rapidly winning its way, is brick. In Toronto it is somewhat cheaper than asphalt, and could a good vitrified brick be supplied at a reasonable figure it would come into general use in replacing the cedar blocks which were so extensively laid down some years ago and which have proved such a failure. Brick is somewhat noisy, but it is not so slippery as asphalt, and is easily repaired and durable. A section of brick pavement at the intersection of six streets in Richmond, Indiana, which has been down for six years, and subject to heavy traffic, has not cost a single cent for repairs, and looks as if it was good for six years more. Asphalt and brick are likely to be the two favorite paving materials for city streets in the future.

Macadam will always be employed more or less for

roadways. Heavy traffic cuts it up, but by the use of broad tires this difficulty may be obviated to a great extent. No matter how well constructed, the stones are liable to work out, and it is dusty or muddy according to the season. By the use of trap rock, instead of granite or limestone, the highest perfection of macadam may be attained. There is a large deposit of trap near St. Joseph's Island, on the north shore of Lake Huron, which costs little more than the expense of quarrying. An experiment in its use was made at Cleveland several years ago. Two miles of road was made in one of the parks, which has worn well. The foundation is crushed limestone ten inches deep, then eight inches of trap in three layers—coarse screenings, fine screenings and dust—all well rolled. The road cost $3.10, $3.19 and $3.65 per square yard according to grade. Trap is extensively used in Germany, where it has proved very satisfactory. There are extensive layers of trap rock on the St. Lawrence near Kingston, convenient for loading on vessels, and therefore easily available for use in cities situated on the great lakes.

A very unlikely material for paving has been employed in the vicinity of the stock yards in Philadelphia. It is supplied from a plant set up at Norfolk, Virginia, to manufacture the grass that grows in the salt water marshes into paving blocks. The grass is subjected to enormous pressure, and then cut by circular saws into blocks 5½ inches thick. These are treated in three tanks containing different kinds of oil, which renders the fiber supple. A wire helps to hold each block together. The pavement is said to be smooth, noiseless and free from slip. The most remarkable paving material which the readers of this journal probably ever heard of is molasses! In the process of sugar refining in the Southern States large quantities of molasses are produced, which is a waste material, sometimes difficult to get rid of. The head chemist of a refinery in Chimo, Cal., bethought him of a means to turn it to account, and he had a walk, 1,000 feet long, constructed of slabs of molasses mixed with sand. It dried quickly, became hard and was not affected by the sun. A slab two feet long and one foot wide was tested by being placed on supports for a couple of inches at each end. When struck with a heavy hammer it showed no sign of either cracking or bending.

As cost is a very important factor in paving, a statement is appended showing the approximate cost per square yard of the pavements in general use in Toronto. The relative cost will be much the same in other Canadian cities. The figures are for a roadway 24 feet wide:

Heavy asphalt, 6 inches concrete, 2½ inches asphalt	$2 70
Light asphalt, 4 inches concrete, 2 inches asphalt	2 30
Brick on 4 inches concrete	1 60
" on broken stone	1 45
" on gravel	1 30
Cedar block on 6 inches concrete	1 40
" on 6 inches gravel (wooden curb)	70
Macadam	1 20

THE WHITE SLAVES OF THE PASS.

That there is no slavery under the British flag has been our boast for two generations and we have looked not uncomplacently upon the people of the United States, who by law made all men free and equal, yet for many years bought and sold their fellowmen in the open market. It is no longer lawful for a man to sell himself into bondage, or his wife or children, to pay his debts, but in Canada we have discovered recently that men may be decoyed into the waste places of the earth and there forced to toil their lives out in misery at the pistol's mouth. We quote one paragraph from the voluminous report of the commission appointed by the Dominion Government to enquire into the subject: "We note some special facts, such as, for instance, the fainting of men on the works; the refusal on the part of teamsters, whose wagons were hardly loaded, to give a ride to wounded men, such as young Joseph Bourgignon and Theodore Lambert; some threats of Noble, one of the foremen, to kick them; the alleged bad treatment by the same foreman of men who had had difficulties with the company, and who were discharged one day after they had returned to work; the refusal of food generally to all men discharged or quitting work, and the hardship experienced on account of this, which caused one Weir, for instance, to faint, and others to feel very weak, three men having to subsist for a whole day on one onion; a pinch of salt refused to men leaving camp, which they asked for in order to salt fish they might catch with a fish-hook given them by one of the men. All this when they were at distances ranging from 70 to 150 miles from, and having to walk to McLeod, often having no money, and, even with money, being unable to obtain food, and having sometimes to rely on remnants thrown away on the road." We do not repeat the tale of horror which recites the death from most painful disease of men who passed their last hours under such conditions of exposure to hunger and cold that their companions who were in health could not have avoided freezing except by the most continuous exertions.

The president of the Canadian Pacific Railway when interviewed on the subject is reported to have said that the contractors could not provide feather beds for the laborers. When a public complaint was brought to the attention of Sir Wm. Van Horn's fellow-countrymen, that other great United States railway dictator, Jay Gould, he said, "The public be d——d." The question which should be considered by every thoughtful Canadian is whether we are governed according to the B.N.A. Act or the C.P.R.

SANITARY EXPERIMENTS AT COLOGNE, GERMANY.

BY W. M. WATSON.

The city of Cologne, Germany, reframed its plumbing and private drainage by-laws, some years since, to comply with the fashion of the times, ordering back-air vents on all fixtures, and also traps and breathers on the main line house drains, but, after giving them a few years' trial, it was proved that the advantages of the system were not equal to expectation, or even so good as the method previously employed, which was erecting the appliances with as much simplicity, coupled with good workmanship, as possible, and a short time since the city fathers appointed a committee, together with Herr Maniewski, the leading architect, and Herr Unna, the noted sanitary engineer, to make a thorough investigation of the whole system.

The committee erected sets of soil pipe and drains made from glass; they also had a variety of water-closets, traps and small waste pipes made from the same material, and fixed them to a temporary erection, consisting of three flats, in the most public place in the city. They also got permission to cut out and examine a number of the oldest back-air vents in the city. They had been in use several years. Having lately finished the investigation, their report has been published in detail in No. 4 and 5 of the Gesundheits Ingenieur for 1898, a German engineering journal, and as the experiments are of great importance, the report has been republished in the English-speaking papers. This report relates that all the old back-air pipes the investigation committee cut out were choked up with either grease or coffee grounds, or cobwebs, which would of course prove that the vents had been useless, on several

grounds: 1st, Because none of the traps to which they were attached could ever have been in danger of being siphoned, or the back-air pipes would have passed down air to break the vacuum in the waste pipe, and to relieve the draw or suction on the water seal of the traps, and if any air had ever passed down the vent pipes there would have been no cobwebs choking them. 2nd, That they create complications, expensive intricacies and obstructions, interfering with the smoothness of the waste water flow, and are liable to become blocked up with the most poisonous and dangerous part of the sewage, viz., the frothy scum odors.

In the experiments the committee noted the influences of the sewage and air on various sized soil pipes at various grades and inclinations, also in vertical and horizontal position, and studied various sized traps, back-air pipes and connections, and depths of water seals. The influences on the flow of sewage, when the soil pipe was extended through the roof and the end left full open; when only partly open; also when the head of the soil pipe was totally closed up, and when the heads of the soil pipes and the back-air pipes were enlarged in the usual way immediately before passing through the roof. Also the action and influences on the private drains when main line traps and breather pipes were used. They found that a solid piston or column of water was only formed when the waste water from the fixtures was passing through inclined and horizontal pipes. And we know that when a piston is formed that there will be a suction of air or a vacuum behind the column that would siphon the trap or a number of traps, under certain conditions; but as such conditions never occur when the plumbing is installed by a competent person and used properly and in an ordinary way, it is a waste of money and is contrary to sanitary science to use back-air vent pipes.

They appear also to have proved that there is a limit to the pressure of the suction and the vacuums caused by water pistons, which can be overcome by arranging the plumbing so that no inclined branch can be longer than 39 inches, or by increasing the depth of seal in the traps, and by increasing the size of the waste pipes to about three times the capacity of the strainer or the mouth of the inlet. But our experience has proved that all risks can be avoided by making the branch from each fixture as short as possible, and branching them direct and almost level into a line of waste pipe that is extended through the roof, and the end left opened, so that the air can be drawn down when necessary. See illustration and full explanation in the issue of this journal for April, 1897.

The committee found that there was no advantage in increasing the size of the head of the soil or ventilation pipes as is customary at present, except it was possible to decrease the interior by hoar frost in winter, and this they were unable to demonstrate. When water was poured down one of the smaller fixtures it dashed against the opposite side of the vertical soil pipe, and at once resolved itself into fine, single threads, as if delivered from a sprinkler, and the number of threads increased in proportion to the amount of water poured down, until the bore of the soil pipe was entirely filled with thread, which acted as an air injector into the sewers and aerated the waste water passing down at the commencement of its flow towards the sewer mouth. In order to gain a knowledge of the amount of air sucked into the soil pipe an anemometer was carefully fixed on the mouth of the soil pipe above the roof, and one bucket of water was poured down a fixture when the anemometer showed that three cubic feet of air had passed down, and when four pailfulls were rapidly discharged down a fixture there were 17¾ cubic feet of air carried down with the water. Supposing the four pails held two cubic feet then it would prove that the water carried over eight times its own bulk of air with it down the soil pipe into the drains. When water was poured in at the top of the vertical soil pipe the moisture of air sucked in was only half the amount that was drawn in when discharged into the soil pipe through a branch. When the head of the soil pipe was partly closed the number of threads was reduced proportionately, and the seals of the traps showed signs of agitation, and when the top of the soil pipe was closed altogether and the four buckets of water were poured down quickly the water did not break up in threads, but formed a piston which siphoned the traps of all the fixtures except those that branched into a secondary line of waste pipe that had an open end above the roof. When the sewage was flowing through the horizontal sewer it formed a concave surface which largely increased friction and reduced the speed.

When any of the small waste pipes were extended at the upper end and the end left open so that air could pass down when required, the same result was obtained as when experimenting on the soil pipe.

It was shown that when a main interception trap was used, that it not only modified the speed and partly obstructed the flow of sewage, but it prevented any of the air carried down by the soil and other waste water pipes from discharging into the street sewer where its aerating functions are so necessary to commence the purification of the sewage in the drains and assisting in preventing sewer gases generating in the sewers. It was also shown that when the main interception trap is omitted there is a superior and self-cleansing flow of sewage, and that large volumes of air pass forward to the street sewer, creating a healthy atmosphere and circulation of air down the soil pipe through which the fluid is passing, and up other soil pipes that are at the time standing idle.

These experiments, especially those that show that air is carried down with waste waters and that the main trap is a dangerous obstruction, fully explain the reasons why those towns that do not use back air pipes and that extend their soil pipes from the crown of the drains to the highest point of the roof and which make every rain water leader and waste water pipe to pass to the street sewer without any obstructing trap or sharp angles or interruptions of any kind, are almost free from odors in the houses and streets, and free from diseases that can be traced to sewer gas poisoning. While, on the other hand, those cities which have adopted the principle of interception traps, back air ventilation pipes, with all their intricate complications, are often quite the reverse, and of disease a great deal is found among the inhabitants who happen to live in the modern built houses where the obstruction system has been installed. And this is in spite of the fact that the same towns often spend large sums of money in flushing drains and artificially ventilating the street sewers, a thing which is never necessary if the sewers are laid down properly and the straight unobstructed system is adopted. The city of Cologne has now had enough of the complicated system of plumbing and draining and in future will avoid such expensive luxuries and again allow their sewage water to leave inhabited premises with as much expedition as possible, and secure all the aeration it can throughout the journey to the outfall, without making itself a nuisance to the public.

The Cologne investigation has a bearing on sewage purification. It will be remembered that more than twenty years ago Dr. Pasteur, of Paris, and Dr. Warrington

declared that sewage contained the necessary organisms for its own purification. Dibdin, of London, England, has shown us the way to compel sewage to clean and purify itself. Adney, of Dublin, has proved that domestic sewage requires three times its own bulk of air regularly and evenly supplied and distributed to every particle or atom of the sewage to enable the friendly bacteria to destroy the poisons, etc., the sewage contains. Lowcock, Birmingham, has shown us a method of applying the atmospheric air to the sewage, and Reid, of Staffordshire, recommends that all sewage should be purified while fresh before putrefaction sets in or sewer gas begins to generate The fathers of the city of Cologne have shown us by their experiments that the sewage will split up into fine threads of spray and take up atmospheric air in larger quantities even than Adney tells us is needed during the time it is falling vertically down the waste pipes. Therefore the bacteria can secure all the oxygen needed for a short period and when the sewage is in a fresh state. If every house rain water leader and waste water pipe were made to form a street sewer ventilator, and the water coming down each of the pipes will bring down four times its own bulk of air, which will go a long way towards providing all the air that is needed to do the necessary work of cleaning the sewage, and in that case the public sewers will be changed from a gas generating chamber to a receptacle for the aeration and purification of sewage and dirty filters, in that case they would be harmless. While under obstructive plumbing by-laws and private drain arrangement of interception traps, no aeration of the sewers can take place, therefore putrefaction immediately sets up and sewer gas is generated abundantly, which poisons the dwellings and the atmosphere of dense populated towns.

The Cologne investigation has demonstrated that most sanitary appliances can and ought to be made of glass, that all soil pipes and lines of waste water pipes should finish with an opening outside, that no rain water leader should join to soil or waste pipe until it reaches a point below the inlet of the last branch pipe coming from the lowest sanitary fixture.

The German scientists are reliable, and their experiments and judgments can be acted upon with safety, and the expensive experiments they have made may be freely taken advantage of by other towns.

THE QUEEN CITY OIL COMPANY.

The location of business houses in Toronto has been undergoing considerable change of late years, and the tendency of trade has been towards concentrating on Yonge street, as near King as possible. Among other well known firms which have moved with the times is the Queen City Oil Co., which has just transferred its extensive business from 30 Front street east to the handsome new Lawlor Building, corner King and Yonge streets, Toronto. The offices occupy the whole of the flat, a dimension of 60 x 90 feet, with 14-foot walls, and are the finest in Toronto for ventilation, light and convenience. They will be occupied by a staff of twenty-five, the hands employed in Toronto, the headquarters, numbering about 200.

The phenomenal progress made by this organization during its history of nearly a quarter of a century is largely due to the tireless energy, conspicuous business ability and unswerving integrity of Samuel Rogers, the founder and present manager of the company. When Mr. Rogers started in the oil business in 1876, he found difficulties confronting him in every quarter. But armed with an iron will, and a resolve to be second to none, he overcame the obstacles one by one. From the very first he determined to encourage Canadian industry, and he has resolutely persevered in that course, to the advantage of the people at large, as well as of the large force of men in his employ.

With the firm, Fairbank, Rogers & Co., he opened a refinery at Petrolia, which has since been merged into the refinery at Sarnia, now the largest in Canada. Although he is now over sixty years of age Mr. Rogers has not relaxed his efforts in one particular, and he is still the central moving spirit in the large and successful company of which he is the founder. He has now associated with him in the company his two sons, Albert S. Rogers, secretary and treasurer of the company, and Joseph P. Rogers, manager of the lubricating department.

The Queen City Oil Company, besides the works on Princess street, Toronto, has branches established in all of the principal towns in Ontario, and sells in Canada the products of the Standard Oil Company. By care in treating the oils they have been able to furnish a product at least equal to the best American oils, and the company has gained the confidence of the public wherever its goods have been offered. The various oils are too well known to need extended mention, Among the best known are the Sarnia White Burning Oil, and the Peerless Oil for farmers' use, one of the best lubricating oils on the market.

Altogether Mr. Rogers is to be congratulated upon the success which has crowned his labors during the past quarter of a century.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during May and the four months ending May, 1897, 1898:—

	Month of May.		Five months ending May.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£7,730	£2,131	£25,647	£10,243
Pig iron	563	569	1,018	5 793
Bar, etc.	316	1,143	4,205	5,110
Railroad	6,935	..	20,286	6,972
Hoops, sheets, etc.	5,436	6,122	16 445	11,592
Galvanized sheets	3,975	6,909	15,998	20,980
Tin plates	8 652	21,423	80 972	61,968
Cast, wrought, etc., iron	3,880	3,408	14,965	13,658
Old (for re-manufacture)	.. ..	606	572	1,504
Steel	3 493	4,877	18,480	24,298
Lead	1,672	3,745	4,454	8,050
Tin, unwrought	1,609	3,157	8,923	9,087
Alkali	3,533	5,179	11,722	16,737
Cement	1 825	2,771	4,778	8,262

SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER:

My attention has been drawn to a letter published in the June issue of the CANADIAN ENGINEER signed by "Expert," which is false, malicious and libelous in its statements. I hereby ask "Expert" to be manly enough to come out in his own name and repeat his statements so that I may have an opportunity to meet him in the open; I will not brand him as a coward yet until we see whether or not he will have the manliness to sign his own name as requested.

Yours respectfully,

JOHN MACDOUGALL.

635 Cass Ave., Detroit, Mich., June 22nd, 1898.

Editor CANADIAN ENGINEER:

There is an article in the June issue of your valuable periodical signed by "Expert," which contains misrepresentations of the sewage and garbage disposal processes mentioned therein which I consider to be injurious to the Company represented by John Macdougall, therefore, in justice to that company, provided his statements are true, the writer of the article should have had the manliness to sign his own name instead of a nom de plume. My knowledge of the International processes of sewage disposal and of Warner's garbage destructor, which has been obtained from a long period of study of such subjects, as well as from a personal examination of many works of that character in Great Britain last year, has compelled me to arrive at but one conclusion, namely, that the above-mentioned processes for the disposal of sewage and for the destruction of garbage have no equal either in Europe or America for efficiency and economy in their operations, and I am backed up in that opinion by many of the leading sanitary scientists in those countries, especially in Great Britain. Let "Expert" come out like an honest man under his own name, which he should do if his statements are true.

Yours very respectfully,

J. A. SMITH.

Windsor, Ont., June 27th, 1898.

THE CANADIAN ELECTRICAL ASSOCIATION, PHOTOGRAPH TAKEN ON THE DAM OF THE CHAMBLY MANUFACTURING COMPANY.

CANADIAN ELECTRICAL ASSOCIATION.

EIGHTH ANNUAL CONVENTION.

The eighth convention of the Canadian Electrical Association was held in the Windsor Hotel, Montreal, on the 28th, 29th and 30th June. On the first day, the meeting, which was the best attended in the history of the association, was called to order by the president, John Yale, manager of the Guelph Light & Power Co., shortly after 10 o'clock. After the reading of the minutes of the last meeting by the secretary, C. H. Mortimer, Mayor Prefontaine, of Montreal, was introduced, and welcomed the convention to Montreal. The president said that all were pleased to receive the greeting of the Mayor of Montreal, and called upon A. A. Wright, of Renfrew, to support him in his statement, which he did in a neat three minutes' speech.

The president then read his address as follows: "I beg to give you all a hearty welcome to this the 8th convention of the Canadian Electrical Association. The aim of the association is to gather together the members of the Electrical Fraternity, and allied interests for the purpose of mutual discussion, and to learn from each other's experience. In this way we try to benefit the whole business interests with which we are all connected. An organization of this kind confers upon its members benefits from the reading of papers, and the discussions which take place disseminate information with reference to the methods that are constantly being tried by different members in the practical conduct of their everyday operations and business methods. This association affords the means for members to become acquainted with one another. The friendships here formed should be used for the purpose of mutual protection and advice when difficulties arise. A free and friendly correspondence tends very much to strengthen, stimulate and encourage many of us in our daily struggle with difficulties. It is a matter of satisfaction to me that during the last two years you have honored me with the office of president, good progress has been made in the direction indicated; but there is still room for great improvement.

It is now almost four years since the last meeting of the Canadian Electrical Association was held in the City of Montreal. During the interval conventions have been held once in Ottawa, twice in Toronto, and last year at Niagara Falls. On each occasion matters of current interest and importance have been presented for the consideration of our members. There are many reasons why our meeting, again this year in the east, and particularly in Montreal, should be at once a source of both pleasure and profit to the members of this association. The intervening four years have done much for the Dominion of Canada, for its national life and the development of its material resources. In no department of industry has this progress been more marked than in the electrical field, in electric lighting, in electric railway work, and in the electric transmission of power; and the work must not be forgotten which has been done in extending the use and improving the service in the older branches, the telegraph and the telephone. From this development of the great modern industry in which we are all proud to have a share, no part of the country is likely to reap greater benefits than the City of Montreal and its vicinity.

The Dominion of Canada, at least, so far as Ontario and Quebec are concerned, while otherwise abundantly dowered with mineral riches, has been deprived of coal deposits, until recently an essential factor in manufacturing and industrial development. To-day, however, the possibilities of electrical transmission have rendered available as a substitute to turn the wheels of our factories, the heritage which both provinces possess in their abundant water powers. It will be our privilege to inspect what has been done in this direction by some of her far-sighted and enterprising citizens for the City of Montreal. We shall first see that great enterprise, carried out in the face of difficulties and discouragements, the successful utilization of the power of the St. Lawrence river by the plant of the Lachine Rapids Hydraulic and Land Company. Of equal interest and importance will be the opportunity given of inspecting the plant and equipment of the Chambly Manufacturing Company on the Richelieu river at Chambly, which will vie with its great rival in the beneficent work of supplying cheap light and cheap power for the citizens of Montreal. It is to be hoped that a fair dividend will be the reward of the shareholders of the two companies for their enterprise. It is proper, before entering on the work of this convention, we should glance briefly over the progress of the past year. A marked feature of electric progress in the Dominion throughout the years 1897 and 1898 has been the inception, and, in some cases, the completion of a number of important plants for the long distance transmission of power. In the Province of Quebec there are besides the two plants already mentioned, the Montmorency plant, which has been in operation for several years, and is no doubt familiar to most of you, and the North Shore Power Company, Three Rivers, a 16 mile transmission, 12,000 volts, delivering 500 k.w. In Ontario there is the Cataract Power Company of Hamilton, the distance to be transmitted 33 miles, pressure 25,000 volts with a capacity of 6,000 h.p. This plant, it is anticipated, will be in operation by August 1st next. In British Columbia a transmission installation of 1,500 h.p. capacity is being erected to supply energy for the Electric Railway, lighting and power industries of the City of Victoria, distance 16 miles. The West Kootenay Power Company recently started with an initial capacity of 2,000 h.p., pressure 20,000 volts, distance 30 miles. This power will be used for the operation of machinery in the mining districts. We have already referred to the enormous development under way in the vicinity of Montreal.

The only point at which satisfactory progress cannot be reported is at Niagara Falls, where, unfortunately, the tying up of the greatest water power in the Dominion in the hands of an alien corporation has prevented its development for the benefit of the people of Ontario. This state of affairs, we trust, will be removed before another year. Besides the important plants mentioned which are either in operation, or in course of construction, a large number of similar enterprises are at present in their initial stages and may be expected to reach their completion within the next year or two. Altogether, it is difficult to foresee at the present moment the benefits which our Canadian manufactories and industries generally may derive from the utilizing of the water powers of the country, scattered without number from the Atlantic to the Pacific. In electric railway work the development of the year has been mainly confined to the extension and the better equipment of existing city and suburban roads.

In the field of electric lighting, in which a majority of the members of the association are more particularly interested, a reasonably satisfactory condition of affairs exists. That industry is on a fairly solid basis, at least, in so far as a distribution of current for incandescent and power purposes is concerned, as rendered evident by the failure of the much-talked-of illuminant of the future, acetylene gas, to make any inroad into the field of the lighting companies. A large majority of the plants now in operation are equipped with reasonably modern and efficient machinery, and the rates at which current is supplied are, it is safe to say, if taken on the average, the lowest in the world.

We will have before us the report of the Committee on Legislation. From this you will see how far the efforts made since our last meeting have been successful in the direction of securing equitable protection of private investments. It is to be hoped that the work of the association during the convention will be helpful to the members and that they will recognize the value they receive from their attendance here with respect to the papers which have been prepared for the convention. You will see their practical and helpful nature, and I trust you are ready to criticize and discuss the views set forth in the light of your own experience. One thing more I feel should be mentioned, and that is, the appreciation of the efforts of the different companies and individuals in Montreal who have so heartily co-operated for the success of this meeting. The proverbial hospitality of our metropolitan city is known to you all. A pleasing feature at our last convention, was the regular and prompt attendance of members at all sessions and the keen interest taken in the proceedings. This commendable practice will, I trust, be kept up at this our eighth convention, now open for business.

The president then nominated B. H. Reesor, Lindsay; A. B. Smith, Toronto, and C. B. Hunt, London, as a committee to suggest the names of the Standing Committees.

A. A. Wright, of Renfrew, then read his paper on "How to Overcome Some of the Difficulties Encountered by Central Station Men."

HOW TO OVERCOME SOME OF THE DIFFICULTIES ENCOUNTERED BY CENTRAL STATION MEN.

BY A. A. WRIGHT, RENFREW, ONT.

In treating this subject I shall do so from the standpoint of one who has to deal with customers living in a town of moderate size, and not from that of the owner of a plant in a large and populous city, because the circumstances would be, in many respects, quite different, and the requirements, as well as the mode of arranging the service, would be altogether different. I shall take it for granted that the central station is equipped with an arc and incandescent plant, that the proprietor not only does commercial lighting, but supplies light to the corporation as well.

1st. Let us take up arc lighting on the street. This brings us at once into contact with the corporate fathers, many of whom know nothing of arc lighting, except that it is not only necessary, but their special duty, to appear wise in order that they may look well after the interests of the town.

And now let me make my first suggestion, and that is, that you leave municipal politics entirely alone. If you have an inordinate craving after politics, which you have not the power to restrain, let your light shine before the throne of the Legislative Assembly or in the chamber of the House of Commons, but restrain yourself from meddling with municipal politics, lest you make to yourself enemies who will be sure to avenge themselves, sooner or later, in crippling your lighting contracts with the corporation. I do not wish you to infer from this that you should not exercise your franchise when the day for voting comes around, but on the contrary, let it be known that you and your employees always vote for the progressive and enterprising men of the town, and as every aspiring alderman will want your assistance, you if you do not make too much noise, will generally manage when he is elected to get his. Be careful not to make political enemies but to have as many of the town authorities with you as you possibly can. In most towns the contracts for street lighting are made annually, and not as in cities, for a term of years. See to it then, that your contract is so arranged that it shall terminate on the 1st of March. You can do this by informing the proper authorities that your books are so arranged that your Electric Light year begins on that date. Then see that the following harmless looking saving clause is inserted near the closing part of the contract. "And it is further agreed that either party may terminate this lease at the end of its term by giving the other thirty days' notice in writing prior thereto, and in default of such notice this agreement shall continue in force after the termination thereof, for one year, and upon the same terms and conditions as are herein expressed, and in like manner thereafter, unless such notice is given at least thirty days before the corresponding date in each succeeding year, a like renewal and extension of this lease from year to year shall be considered as made and executed by and between, the parties hereto." Furthermore have your payments fall due quarterly and on the 1st of March, June, September, and December. You know that in Ontario at least, our municipal elections are held at the beginning of the year, and as most of the aldermen will be aspiring to re-election, and would like to have your assistance to re-elect them, they will quite naturally forget, as the term of their holding office is drawing to a close, to give notice of the desirability of terminating that contract, and you almost invariably escape that threatened danger from the outgoing council. Then the new council does not assemble till the last of January and as very little business is done at the first meeting and many of the members are new ones, Electric Lighting is not thought of till your quarterly account is presented in March, when it will be too late to give the required notice, and so your contract runs on in this manner from year to year, renewing itself without any trouble whatever. Another difficulty, which you are almost sure to encounter, is the height of the poles on which your lights are placed on the streets. Some will want 50 ft. poles some 75 ft. and some even higher than either of these. When your contract is made be sure and have the clause worded in this way. "That the hangers from which the lamps are suspended shall be——feet from the natural level of the surface of the ground at the foot of the pole," and not, that the lamp shall be so many feet high, as you will notice that this makes an important difference in your favor. It is well to have it so arranged that you need not run your arc plant on moonlight nights, not merely on account of the direct saving that there is in this, but it sometimes is very convenient, if there are accidents, in giving you an opportunity to make needed repairs.

And now as to your commercial lights. Have your contracts made with your customers on a yearly basis, with same renewing clause that there is in your contract with the town, but with this difference, that the payments in this case be made to you weekly, and then see to it that you make your collections in this way, for a man will frequently pay you a small sum weekly, when he would not pay the same amount if paid quarterly. It may not be amiss to mention that in all these contracts, when stating the candle power of the lamps you are to furnish, that you should be sure and employ the words "nominal candle" power, as it may save you, under certain circumstances, no small amount of trouble also

And next, as to your incandescent service. This will, of course, be largely, if not entirely, a commercial service. You will have all manner of people to deal with and you may expect, in many cases, to have your patience sorely tried.

Then to begin at the beginning. Never under any circumstances do free wiring. By that I mean that you should never undertake to wire a house for nothing, in order that you might thus get a customer for your current. Of course you should do all primary work as low as possible, but not at a loss If your power is at all limited or if you run by steam, you will find, in my opinion, that you will make more by running your lights on the meter system than you will by giving a flat rate, unless you get an exceptionally good price for them.

I understand that in many places it is customary to take the readings of your meters quarterly, as it thus saves a good deal of time in taking the readings, making out the accounts collecting them, etc. In this, as in other things the old adage holds good that "Short accounts make long friends" and by no means should you allow your accounts to pass more than one month without being rendered and if possible collected It might not be so bad, in the short nights of midsummer if quarterly collections were adopted but in the end it will amply repay you to take your readings on the first day of each month, and make your collections on the 2nd.

And now as to the location of your meters. We were instructed when installing our plant to locate them in some out-of-the-way place, where they would not be seen, and high up, so that they would not be meddled with. Now this may all be very good advice in its way, but my advice to you is, not of course to put it in the parlor, or in such a place as to cause it to be an objectionable feature in the household, but, be sure and place it low enough that your man can get at it with as little trouble as possible, and also in a place where there is an abundance of light, so that the readings may not only be taken quickly, but accurately. When you have a large number of readings taken monthly, it becomes a matter of some moment that meters be so arranged that the work can be done quickly and accurately as well. You will be frequently told by your customers that the meter is wrong—that they know they never burned that amount of current. In such pronounced cases as these, when the assertions are very strong, I find it is better at once to say, "Well, it is possible as you say that there is something wrong; you know we are none of us infallible; we will see and have a second reading made at once," and look into the matter and at once, do as you have promised, no matter though you feel almost sure that it is all right. You may find that there is an error, and if so you should of course immediately see that it is corrected, but if you find that the reading is correct, and that Mrs. Julius Caesar still insists that that meter is no good, and declares that the thing runs whether there are any lamps on or not, and tells you in a most emphatic manner that she can hear the thing sing like a rattlesnake, lights or no lights, and she knows that it runs on wheels, what then? Above all things do not allow yourself to answer back harshly, for doubtless she really is sincere in her protestations, and it is not wise to contradict her too rashly. I have found a good remedy in replying that of course it is just possible that the meter is not absolutely correct, but that you feel quite confident that it is, and that to cover just such cases as these the government has appointed an electrical expert, to whom both parties can appeal, and if she, after considering the matter over, still thinks there is something wrong, that you will write and have the inspector come up and examine the meter, and if he finds it wrong, that you will bear all the expenses connected with the inspection, but if it is correct that she is to bear all expenses. Tell her just to think the matter over and let you know, and so far as my experience goes that ends the matter.

Another difficulty that you will doubtless meet when running on the meter system is in having your customers send out of town for 5 c.p. lamps and when only one of these is used your meter will not respond. This you will easily discern when at the end of the month you perceive that no current has been consumed, and I may just here mention that this is another reason for taking your readings monthly instead of quarterly. Such cases are not numerous, yet they do turn up where the family is small and its members are contented to do with a minimum of light. This difficulty can also largely be overcome by making a minimum rate of say 50 or 75 cents per month, which amount can be arranged according as the circumstances of the case may require.

There are of course many other difficulties that central station men have to deal with, but it is impossible to consider many in an article of ordinary length, and the remaining ones will be left for others to treat with, as they, in their wisdom, may see fit.

J. F. H. Wyse, Brantford, said he had been much interested in the paper. He had recently been through the mill in dealings with the Brantford, Ont., municipal authorities. He found the sending of notices, the third being an intimation that the supply would be cut off by a specified time unless dues were paid, was a very effective method of dealing with slow payers. C. B. Hunt, A. A. Wright, B. H. Reesor and A. B. Smith followed in much the same strain. C. B. Hunt then moved and A. B. Smith seconded, a vote of thanks to the reader of the paper and the meeting adjourned.

The members reassembled in the afternoon at 2 o'clock when W. H. Browne, manager of the Royal Electric Co., Montreal, read Louis DeWitt Magie's paper on the "Electric Utilization of Water Powers."

ELECTRIC UTILIZATION OF WATER POWERS.

By L. D. W. Magie.

The utilization of power going to waste in fast running streams has commanded for many centuries the attention of mankind. Regarded, on the whole, as "wasted energy" and as power that could be obtained "for nothing," the question of how to make it useful perplexed our forefathers, and is still giving us some study to-day. Although it would appear that, during the reign of Augustus, about 40 A. D., the first water wheels were made and used by the Romans, the scientific development of the water wheel appears to have been left until the present era, for until within the last few years, comparatively, the only devices used to convert the kinetic energy of streams into effective mechanical energy were the various forms of undershot and overshot wheels Crude as were these instruments, they have played a most important part in the world's history, for they have done much to develop countries with natural resources. Manufacturers who sought cheap power adopted the "wheels" available and located their plants along favorable streams, where these crude transformers of energy were made to grind corn, saw wood, make cloth, etc. The inventors of the present century awakened to the necessity of improvement and have provided the present types of wheels. To their higher perfection and adaptability is due the fact that almost every power producing stream in settled districts of the civilized world is utilized.

The harnessing of water powers is not an easy task, but requires a great deal of thought, scheming, trying and fitting by the engineer. The records of the stream have to be looked up and studied into, with reference to high and low water, during a period covering many years, and due provision made for getting rid of the maximum flood of every season. The possible storage capacity must be looked after, for oftentimes by a little forethought and a comparatively slight additional expenditure, a stream that naturally gets very dry at certain seasons can be made, by properly arranged storage, to give a practically constant output the year round. Again, by carefully arranging the surrounding conditions, a stream may be made to give for a comparatively short period, when power may especially demand, double or triple its normal output capacity. Probably one of the most important things to study, especially in localities subject to severe winters, is the question of frazile or anchor ice. This is a condition which has caused hundreds of thousands of dollars to be spent, either from the lack of knowledge or want of forethought; in some cases the conditions have been such as to make it almost impossible to successfully cope with them, without expending such sums of money as to practically ruin the enterprise. To overcome it successfully, the only way seems to be to provide a large pond of still water, extending to as great a distance as possible, even several miles, if attainable. Many other details must also be studied before determining the best location of the water motor power house, so as to obtain the greatest available head with the least expenditure. In the study of the question the natural conditions of the soil, water and climate, all have an important bearing, on not only the engineering success, but also on the financial success of the enterprise.

As waterfalls cannot themselves be moved from one place to another, manufacturers have had to locate the sites of their plants at the falls. In many cases it is necessary, and in nearly every instance very desirable, that the power be transmitted to a certain distance. When the distance has been comparatively short it has been accomplished by belting, gears and line shafts, but when the distance extends beyond a few hundred feet, this system becomes so inefficient, expensive or impracticable, that some other way has to be found. Rope transmission has been used quite successfully, even to a distance of a mile, and in a few instances over that distance, but as the best practical efficiency is not over 60 per cent., and the first cost, as well as maintenance, is usually very high, this system has not yet been so successful as to command its adoption very extensively. Compressed air has also been used for the transmission of energy with some success, more particularly in Paris, where there is a large plant still in existence; but here again the engineering cost has been great, efficiencies low, and maintenance high, and consequently, like the rope transmission system, has not met with general use and practice. The electric dynamo and motor have given an entirely different aspect to the transmission of energy. Although invented in the early part of this

century, it is, however, only within the last few years that the electric dynamo and motor have been developed practically and commercially. The success and high efficiency attained by electric transmission of energy is such that the "waterfall" is gaining prominence as a source of energy.

The pioneer work in electrical transmission was done with direct current system, and too much credit cannot be given for achievements attained. However, although in a few instances the distance transmittted by the direct current system has been up to twelve miles, yet, on the whole, for commercial reasons it has not been desirable to transmit power by direct current to a distance of over two miles, and even the advisability of this is looked upon to-day doubtfully. The reason for this is not because of the inability to transmit the power effectively, but because of the inadaptability of direct current apparatus for use at high voltages. The construction of direct current machines is such, having, as they do, so many auxiliary parts, that at high voltages they are very liable to break down, especially at the commutator and armature cores, except with very costly construction, and even then they are not at all sure; at high voltages the brushes are liable to spark and cause trouble at the commutator; and as the high tension parts require continual attention and adjustment while the machines are in motion, they are dangerous to the attendants. Probably, however, one of the most important reasons for the inadaptability of direct current machines for long distance transmission at high voltages, is the inability to reduce the voltage to that at which it would be safe to operate at the place of consumption without the use of expensive and cumbersome as well as inefficient banks of motors. Such motors of high voltages, having parts under high tension which require attention and adjustment while in motion, could not or rather should not be used except under the care of expensive special experts in every separate mill or factory where such motors were installed. To place them in the care of uneducated men would be unwise, and, in fact, foolhardy. The highest voltage that D. C. apparatus can be wound for, commercially and safely, seems to be, as universally adopted, from 500 to 600 volts. The reason that power at this voltage cannot be transmitted great distances is purely a commercial one. There is no electrical reason why power by the means of direct current might not be transmitted to an indefinite distance, entirely effectively and successfully. The amount of copper required for the transmission of power is directly proportionate to the amount of power to be transmitted, and also directly proportionate to the square of the distance for a given efficiency. This may be stated commercially by the amount of copper required for transmitting, say, 100 h.p. for both one and ten miles, the loss in transmission to be 8 per cent. and the voltage to be 500 volts. For each leg of a one mile circuit there would be required two No. 0000 wires, or four No. 0000 wires, each one mile long, weighing 15,312 pounds, which at 15 cents per pound would cost $2,300. For each leg of the ten mile line there would be required twenty No. 0000 wires or forty No. 0000 wires, each ten miles long, weighing 1,531,200 pounds, which at 15 cents per pound would cost $230,000; or the power would cost, at 10 per cent. interest and depreciation on copper alone, $2.30 per h.p. annum in the first instance, and $230 per h.p. annum in the second case. If, however, the voltage be raised to 5,000 volts, and be used for transmitting 100 h.p. for ten miles, the condition would be entirely different, for instead of forty No. 0000 wires, each ten miles long, there would be required for each leg but one No. 4 or two No. 4 wires each ten miles long, weighing 15,300 pounds, which at 15 cents per pound would cost $2,300, or the same as transmitting the same amount of energy only one mile at 500 volts.

From the above it will be seen that the transmission of power at 500 volts is not entirely prohibitive for short distances, but as the distance increases it becomes one of vital importance, for the cost of copper is not the only item of expense then to be considered; the pole line itself becomes a very grave matter, especially when we have to consider the weight of forty No. 0000 wires, as in the example for only 100 h.p., and the cost becomes one that investors cannot afford, for the reason that power can be obtained cheaper from other sources, so that commercial transmission of power long distances by direct current at practical voltages is not practicable. Although, as stated before, considerably higher voltage than 500 volts has been used with some success, as at Brescia, the number of such plants are very few. It is a noteworthy fact that on this continent, where the transmission of energy is further advanced than anywhere else, there is not a single plant of any prominence that is transmitting energy by high tension direct current system. It may be interesting to know that three or four years ago, when the Chambly plant was first discussed, a European firm planned out and tendered for the construction of that plant for transmitting the energy by means of this high tension direct current system, but, for reasons as above discussed, that system was not adopted.

How to meet the problem of long distance transmission, commercially and efficiently, has been left almost entirely to the alternating current system. Alternating currents were known about the same time as direct currents, or about 1831, and were explained to the world by the great Faraday, who at that time discovered the elementary principles. From that time on, experiments were made by different inventors on induction coils, but no material progress was attained until May 22nd, 1877, when Jablochkoff obtained British patents for "a new process of producing and dividing the electric light and apparatus therefor." There were also other inventors at about this time who produced "improved induction coils on secondary generators," as some of them were called, but all seemed to have the idea that they could be operated with their primary coils connected in series, and that their secondaries could be independently controlled. In 1878 a J. B. Fuller, of New York, suggested a system of using induction coils or transformers in parallel, but no practical results seemed to have been obtained in this direction until 1882, when Messrs. Goulard and Gibbs exhibited two induction coils at the Electrical Exhibition held in Westminster Aquarium in London, which ran in operation from the Siemens alternator. In the autumn of 1884, Messrs. Goulard and Gibbs gave another exhibition at Turin. In this case, the primary circuit was nearly 50 miles in length. A series of transformers were placed on this line, one being in the Exhibition building, one at the Turin Railway Station at Verine Riesla; another at Lanzo, a small village in the Alps of Savoy; incandescent and arc lamps were supplied at the various places. The first parallel system that was started on this continent was by Wm. Stanley, jr., in 1884, in the small town of Great Barrington, Mass., where light was supplied throughout the town by means of a parallel alternating current transformer system. From about this time commenced the era of alternating currents, although as far back as 1849 alternating current generators were devised. Commencing with 1885 the alternating current system made great strides.

To employ waterfalls as sources of cheap power, high potentials became necessary. For these conditions the A. C. was especially effective; the ability to step up from low potentials to high, and thus transmit power to a given distance, then to step down to safe and convenient voltages, entirely effectively, convenient and without the use of cumbrous and expensive apparatus, rendered the transportation of the energy of water powers feasible and commercial. Probably one of the first high voltage transmission experiments on this continent was in December, 1891, and in January and February, 1892, at Pittsfield, Mass., at which test the writer had the pleasure of participating. The potential used was approximately 15,000 volts. A transmission line about a mile in length was built in an open lot a little way out of town, where a small experimental station was built. The current was received from the local Electric Light Company at 1,000 volts, raised to about 16,000, sent out on the line, and thence returned, again lowered, first to 1,000 volts, and then again to 100 volts, at which voltage energy was consumed in water rheostats. On the line experiments were made with porcelain insulators, as well as the oil type of insulators. At this time, of course, comparatively little was known about electric current at this potential, so that everything had to be handled with gloves, as it were. The experiment proved to be not only useful and satisfactory, but highly successful, and gave considerable encouragement. Although experiments were commenced, and discoveries made pointing to the advancement of A. C. motors in 1879, still practical results of any real value were not obtained until in the year 1890 to 1891, when the poly-phase systems were introduced. From that time it can be truly said that water powers could be utilized for the general distribution of power at distant localities. One of the first and most notable exhibitions of this kind was made at the celebrated Frankfort Exposition in 1891, which proved not only interesting to the town of Frankfort,

but to the world at large, for it taught lessons and set aside errors that would have taken years of toil and hard labor to have done otherwise. Poly-phase generators having a total capacity of 300 h.p. were installed at Lauffen and operated by water power. From these, the current was transmitted a distance of 110 miles to Frankfort; several voltages were tried on the transmission line during the experiment, the highest of which was 31,000 volts; in the exhibition grounds were arc and incandescent lamps and small alternating current motors, all provided with current from the hitherto "wasted energy" of the streams of Lauffen, and with a loss of efficiency in the line of not more than 25 per cent., which, at that time, was certainly a most noteworthy accomplishment.

During the next two or three years manufacturers spent a great deal of time and energy in perfecting their systems. The induction motor has been perfected to that of an ideal, and the usefulness and necessity of synchronous motors have been established. For a few years following 1891, an occasional poly-phase plant was put up in different parts of the world. They were subjected to all sorts and kinds of trials, depending upon the character of the work to be performed at each individual installation, and although there was often much cold water thrown upon them at the start, and obstacles placed in their way, still they always came out ahead and proved a success, not only from the engineering point of view, but to the financial backers. When we stop to consider that it has been only within the past six or seven years that a complete system has been devised for the utilization of distant water powers, and that all of the important transmission plants have been put in during that time, it is no wonder that there are yet some sceptics. But perhaps worse for healthful commercial developments are those who make a wild rush for some transmission scheme, without first considering all of its surrounding conditions, thinking that because someone else has made a certain project successful, their project must be also. It falls upon the engineer to bring the sceptic to lines of true reasoning and to teach him facts in their true light, so that he will see and believe, that with such resources at his command, great things are possible; the engineer must also hold the enthusiast in check and prevent waste of money in impracticable undertakings.

The primary or fundamental question is to ascertain the point at which transmission of water powers will be a source of profit to the investor. Many people think that because water strictly follows certain given laws of nature, and in doing so continually and constantly exerts energy, therefore the energy obtained thereby costs nothing. People with such ideas are fortunately gradually growing less as time progresses, although the engineer often encounters men who have a few hundred h.p., or oftentimes when the true facts present themselves, only 25 or 50 h.p., that they wish to transmit five or even ten miles, in hopes of making vast sums of money by the use of this transmitted power in some small town for lighting and power. The cost of electrically transmitted power is represented by the interest on the capital invested; the depreciation; the maintenance; the operating expenses and numerous other small contingencies, and besides, in some cases, the amount of money that has to be expended for water and land privileges. The sum of these accounts per year, divided by the amount of h.p. actually sold, will be the actual cost per h.p. for the case in question. Probably the greatest competitor to electric power is steam power. In a few instances, power derived from gas or petroleum engines may also compete. The cost of producing steam power in any given locality is a fair criterion by which to determine how much electric power should cost. The cost of power produced from other sources can usually be disregarded. The cost at which steam power can be produced in a given locality being ascertained, it can be determined what cost per h.p. may be expended on the construction of an electrical transmission plant to make it profitable to the investor, provided again a sufficient market can be obtained for power. When electrically transmitted power does not cost more than $100 to $140 per h.p. installed, the investment is apt to be a profitable one, providing, of course, it is properly managed.

But what should it cost to harness and utilize water-powers? This is a question that has to be figured out for each individual case, for there are hardly two plants where exactly the same conditions exist. The first item of expense is amount required for water privileges. In some cases this is rather an unimportant consideration, while in others it is the chief expenditure, for it may involve the buying of thousands of acres of land surrounding the stream, because the necessary dams may cause to be submerged a great deal of valuable land, or large tracts have to be bought for building storage reservoirs, or the right of way for pipe lines, etc., have to be secured. When land is cheap, these considerations are often not objectionable, but where good farming land, or land valuable for other reasons, has to be thrown to waste, the question is often a perplexing one. The cost of the dam, power house and hydraulic machinery is, as a rule, dependent almost entirely on the characteristics of the stream being utilized. Entering into the question is the amount of water in the stream, both under normal as well as abnormal conditions at various seasons of the year; also the head or fall and whether it is dependent on natural conditions or requires the building of large dams. Generally speaking, other things remaining equal, generating plants, comprising the power house, hydraulic and electric machinery, as a whole cost less as the head increases, until certain limits have been reached. When the head is low, as ranging from 4 to 10 feet, it requires a comparatively large wheel for a relatively small amount of power, and then slow speeds can only be attained. Where large units are desirable, a number of these wheels must be coupled together in order to get the required power. The speed attainable can be raised or lowered to a certain extent, depending on the size of the wheel. If higher speeds at low heads be desired for large units, many wheels must be operated together, requiring not only a great deal of room, and consequently larger power house, but considerable line shafting, gears, couplings, etc., which not only increase the initial cost, but increase expenditure of operation and maintenance of the plant, as well as introducing another source of inefficiency. With higher heads a larger amount of power can be obtained from fewer and smaller wheels with higher speeds, and, therefore, cheaper generating apparatus.

The cost of generating apparatus for a given capacity, other things remaining equal, is almost directly proportional to the speed at which it runs, and for this reason it is always desirable to refrain from too low speeds wherever possible. There are many people who are imbued with the idea that it is impossible to build a modern station without direct connecting all of their apparatus, and that belting at no time should be used. Although direct connection is desirable, still it must not be carried to extremes. A good engineer will hardly warrant the expenditure of, say, $15,000 for a 300 k.w. generator to run at a speed of say 75 to 100 r.p.m., when a machine just as good in every respect, and sometimes better (because it is a standard size), can be bought in belted units for $5,000. Yet this is sometimes done, burdening the plant with many thousands of dollars on which it has to pay money, for no other reason than that "so-and-so's plant is direct connected and I want a plant just as nice and good as his, and belts are always an awful nuisance." As stated before, direct connected units are always desirable where conditions will warrant them, still it must be borne in mind that belts have been in successful operation now for a good many years, and there are many instances where the maintenance of them has not cost 1 per cent. per annum, and although their use involves a loss of efficiency of somewhere between 2 and 3 per cent., at times of full load, still this loss in a water power plant is not a critical amount, and in fact is almost always inappreciable.

The next item of considerable expense is the transmission line—always rather an uncertain item, on account of its variations in cost for different distances and the conditions of local distribution. The poles, with their appurtenances, exclusive of wire, will cost between $250 to $500 per mile, varying according to circumstances. Rights of way for the placing of poles may often be expensive. The transmission wire must be considered separately. Reference has been made earlier herein to the voltage or size of wire. The voltage at which it is practicable to run now-a-days is reaching vast proportions. There are two or three plants being installed in which 20,000 to 22,500 volts will be used, and a plant is likely to be installed soon that will use 60,000 volts. The use of high voltages in the past has been limited greatly by the insulators. The glass insulator has proven itself insufficient for most climatic conditions. The oil type of insulators was introduced some years ago, and a great deal expected from them. They did give excellent results in the

laboratory, but unfortunately the oil evaporates and the impracticability of renewing the oil, especially when the line is in use, soon put them in disfavor. Porcelain insulators appear to have solved the problem. The trouble at first was to get them properly vitrified, but this difficulty seems now to be overcome, and the insulators have proven all that can be desired when used with the usual voltages now employed. As to whether they will successfully cope with the higher voltages now contemplated is a question yet to be answered. The cost of the transmission wire is often the most important part, but it is always different with each case, dependent, as it is, upon the amount of power to be transmitted, the transmitting voltage, distance, and the allowable loss. As a whole, it is always best to keep the transmitting voltage as low as possible and still keep within commercial conditions. Many people are carried away with the idea that if they could only use high voltages the cost of transmitting would be reduced to a minimum. It must be borne in mind that with the use of the higher voltages the cost of insulators increases, the electrical apparatus necessarily costs more, and moreover, the risks are greater throughout the system, and consequently necessitates more skilled attendants to look after the plant.

All of these items have to be carefully considered before looking into the possible saving of copper on the line. For mechanical reasons, a wire smaller than No. 6 B. & S. should not be used for line work. More cautious engineers will say it should not be smaller than No. 4 B. & S. It is foolish to attempt to use voltages which allow the use of smaller than No. 6 wire. Where a shut-down would mean heavy damages, it might be even advisable to use a wire not smaller than a No. 2 B. & S. If these facts are always borne in mind, the question of voltage will oftentimes adjust itself, and the use of very high voltages will not be found necessary unless the transmission be for especially long distances, and the amount of power particularly large. The permissible drop is dependent upon the power obtainable at the generating station and the amount to be delivered at the end of the line. There are a few instances where power is scarce at both ends of the line, and where it is desirable for this reason to keep the loss of transmission as low as possible, but such cases as a rule are rare, and we are more often met with the reversed conditions. To get good results electrically, the loss in the line should not be more than 15 per cent. If it be more, it will, with the other losses that are necessary in the rest of the apparatus, especially where the load is liable to be a fluctuating one, render good service almost impossible. The figuring of drop on transmission lines should always be left to competent engineers, for with A. C. the question in many instances is not a simple one, because it involves other conditions besides the ohmic drop. When alternating current is sent through a conductor, it has to deal not only with the electric resistance of the wire, but also with a resistance due to the fact that the electric magnetic stresses set up at any point of the conductor, create electromotive forces at other points of the same conductor, which oppose and retard the passage of the current, or in some cases, tend to shove it ahead. As to how far power can be transmitted, the engineer can conscientiously say to an indefinite distance, and he would be fully prepared to figure out, and contract for, if necessary, the fulfilment of his statement, but it rests with the commercial men to cry halt. The distances attainable, however, on a profitable basis, have been growing greater from year to year, as the manufacturers have been prepared to extend the limit to which they are willing to build high tension apparatus. At present it would appear that where the distance to be transmitted is over 75 to 100 miles, no matter how cheap the hydraulic development, commercial competition is not practicable with existing power where coal can be obtained for $2, $3 or even $4 per ton.

The step-down station and the distribution of power are the next items of expense, including the cost of the necessary switchboards, transformers, etc. The location of the step-down station and the method of the distribution of power constitute a very important question. Unfortunately, very often this subject is entirely omitted or overlooked by the promoter, but it is one to which should be given considerable thought. The step-down station itself should be centrally located, so as to make the distributing lines as short as possible. It is not generally advisable that transmission lines of very high voltages and large currents be extended through thickly settled communities where they might be liable to disturbance from fire or accidents of similar character, in the immediate locality of the line. In some places, to enable the distribution station to be centrally located, transmission wires are placed in conduits underground, when they pass through thickly settled districts so as to avoid the danger that would otherwise exist, but this, of course, is expensive construction, and the cost of it must always be balanced against the advantages of having the step-down station centrally located, as against its being placed at the outskirts of the town. All the various items require careful study to obtain least cost and avoid unwise economies.

When all these various factors have been properly adjusted and the resulting condition of the water power electric plant is that the power available twenty-four hours every day is at or about the cost of steam power in any given locality, the future profitable operation will be, no doubt, assured, because the popularity of electric power is not due alone to the fact that it can be produced cheaper than power obtained from other sources, but also to its superiority in other directions. This is evidenced by the fact that in mills and factories, where both sources of power have been tried, electric power is displacing the steam plant. Owners having experience with both invariably state that they would not be willing to return to their former power plants, even if power could be produced as cheap or cheaper than they are now obtaining it for electrically. The reasons for this are very numerous. The power is always on tap day and night, year in and year out; there is no waiting for boilers to be fired, nor shut-downs on account of strikes at some distant coal field; less room is required, and consequently floor space formerly occupied by belts and shafting can now be easily sub-divided into any number or sizes of units, and thus independent departments and machinery can be worked separately instead of from one big unit. Overtime work in any department is much cheaper, for by having departments separately operated they can be run independently at will, without running all the other machinery in the mill. The fire risks are less, and rates of insurance less for mills operated electrically than by other means. Removal of so many belts, line shafts, pulleys, etc., secures less danger to life of mill employees, and the mill is lighter and cleaner, and consequently the health of operatives better. On account of the extreme simplicity of the A. C. electric apparatus, anybody with ordinary intelligence can start it in motion, and thus avoid depending on one or two men. Moreover, with electric power it is possible to maintain a closer speed, which in many instances enables the turning out of a larger quantity of better product commanding higher price; and so on for most every department and branch of business, some advantage is gained without anything lost. All of these advantages are not evident to the consumer before or when he first puts in electric power, and he often refuses to listen to them, thinking that they are entirely imaginary, but a short experience brings the conclusion that electric power is "cheap at any price." It may be interesting to note here that there is a project now on foot in which it is contemplated to transmit 30,000 h.p. a distance of between 30 to 40 miles; the transmitted power to be used in mills now operated through shafts, gears and belting by water wheels, because of the advantages to be gained by using electric power.

The use of electric power is not confined to driving machinery in mills or factories, for it is fast finding its usefulness in other directions. The use for "electro chemical" enterprises is fast reaching vast proportions, and there are plans now on foot for the utilization of at least 150,000 h.p. in this way during the next two or three years. There are many thousands of h.p. being used in the street railways, while the big trunk lines are seriously considering its use, and are continually asking the manufacturing companies for plans and estimates. Then there is the electric welding, the electric plating, the supplying of energy to horseless carriages and electric launches, to say nothing of the hundreds of thousands of incandescent and arc lamps that are used for general lighting. The utilization of the water power by electric transmission has not stopped with the commercial world, but has forced itself into the privacy of our own homes, not merely with incandescent lamps, but with electric cooking utensils, smoothing irons, electric heaters, fan motors, etc. What would our forefathers say if they were told that to-day we are depending on such and such a river, so many miles distant, to cook our meals for us and to have our boiled shirts laundered; but we had better not laugh now, for the coming generations may have as much occasion to laugh at us.

This paper was so admirably read that A. A. Wright jocularly asked whether the position of permanent reader to the association was open. If so Mr. Browne should be asked to take it. Wm. Thompson, Montreal, regretted very much that Mr. Magie's paper, which covered the whole ground before him, had not reached the hands of the members before the day of reading. He (the speaker) was only about 30 years old, but he could remember his grandfather running a mill in England by one of those lovely water wheels on which the water dropped from a great height above. Some friend came along and said, why don't you put buckets on your wheel and catch the water, thus suggesting an improvement which waited years for adoption. Mr. Magie properly pointed out that water motors for electrical transmission had come to stay, and was wise in pointing out to the investor that there are occasions when an electrical installation cannot pay. It is a pity that the installations near Montreal are not more advanced so that the investor could see what returns are likely to be made. The Lachine plant, for instance, represents a large capital that will be locked up there for years to come. In conclusion he felt like proposing that the discussion of this paper be postponed till next year, so that members might have a fitting opportunity of studying it. W T. Bonner, Montreal, thought that the steam men had been slightly disparaged. He expected that during the coming six months some tests would be made of important existing plants which would educe surprising results in favor of steam. He hoped to submit them at the first opportunity. W. H. Browne, Montreal, objected to the postponement of the discussion as it might bring on new phases of the subject and there were several members present who were capable of discussing the paper. He was perfectly aware that steam plants showed up very well in comparison with electricity, and indeed the paper pointed out that the initial cost in many cases rendered the installation of electricity prohibitive as an opponent of steam. But the use of the steam plant at unaccustomed hours involves extra cost while that of electricity does not. The largest commercial enterprise in Montreal has negotiated for electric power and has altered the working hours so as to recoup itself. A. A. Wright, Renfrew, thought the subject, in this age, of the utmost importance. Small towns in particular would be much benefited if the water powers in their vicinities could be used. A. M. Wickens, Toronto, also regretted that the paper had not been handed in earlier. Much could be said in favor of the steam end of an electric plant. You see, he said, this association reaches from one end of Canada to the other and includes many districts where there is no water power, and in such places the steam engineer will crowd his electrical rival very closely. Even where there is water power the results are not absolutely convincing. Take, for instance, the Cataract Construction Company on the American side of the Niagara Falls. No one knows whether they are making anything or not, or what the cost of transmission is. We know that a vast sum of money is sunk there, and that so far very little power is transmitted to Buffalo. About everything else we are left in doubt. J. J. Wright, Toronto, endorsed much of what had been said, but fancied that the steam engineers were not quite so sure of their facts as the electrical. L. De W. Magie said that if it had been his intention to fight the steam men he should have written a different paper. W. Thompson, Montreal, said that Mr. Magie had made his statements mildly, and agreed with much the writer said. The trouble is we put in 20,000, 30,000, or 40,000 h.p. plants and we are able to find customers only for about one-tenth. Too many people imagine that because the waterfall turns the wheel that therefore power ought to be free. Where large installations have been attempted too much money has been sunk to obtain power vastly in excess of the demand. Montreal is of course exceptional because of its promise and opportunities. Still it is not exempt from the charge. B. H. Reesor, Lindsay, moved a hearty vote of thanks to Mr. Magie.

W. T. Bonner, Montreal, then read his paper on "The Unconscious Ownership of an Important Key."

THE UNCONSCIOUS OWNERSHIP OF AN IMPORTANT KEY.

BY W. T. BONNER, MONTREAL.

The first consideration in exploiting any new suburban tramway is the possible or available passenger traffic. That being found inadequate to guarantee a fair return on the cost of installation and maintenance, the project is usually abandoned for the reason that only passenger traffic can be considered, owing to the high cost of handling goods traffic at the terminals. While a motorman and conductor are sufficient to handle a two or three-car electric train for passenger traffic, with very little expenditure of time or assistance for loading and unloading, all railways under present systems require a large additional force to conduct the hundreds of details attending the reception, checking, loading, transferring, unloading and proper delivery, in good order, of either car lot or package freight. It may therefore be conceded that the whole subject presents two phases of commercial economy, viz.:

(a) From the standpoint of the agriculturalist and land owner; how best to provide a means for increasing the value of remote lands.

(b) From the standpoint of the capitalist; how best to increase the earning capacity of suburban lines.

With the ever increasing centralization of population and commerce, inaccessible property becomes less valuable; all land, whether barren or fertile, suffering alike, according to its distance from the centre of demand for farm products, which we call markets. Such distance is not always measured in actual miles, but rather in accessibility, since in our day we find frequent examples of the long and short haul rates. The Minnesota and Manitoba farmers will deliver their wheat at the seaboard at a lower cost per bushel than the farmer who may live a hundred miles off the coast. The eastern farmer may have just as fertile land as his western competitor, but he is handicapped by having to haul his wheat forty or fifty miles over poor wagon roads to reach the nearest railroad. In either case, the terminal charges, including the cost of loading the produce at the farm, is approximately the same, but the difference in cost of haulage per ton-mile by railroad and wagon road is in favor of the former. It has been stated as a fact that to transport a ton of coal from Buffalo to Chicago costs no more than to move the same quantity of coal across the sidewalk in either city. It is frequently asserted that since the introduction and development of steam railways, they have gradually superseded the earlier methods of transportation and traffic, and as a consequence highways are no longer an indication of progress. This is true only to a limited extent. Railroads have changed the character of suburban traffic, and personal travel is no longer dependent upon the condition of the highways, but commercial intercourse, as represented in the exchange of products, is as much dependent upon the condition of the public road to-day as it ever was, for the reason that it is impossible to construct a railroad to the door of each producer and consumer.

Few people have any knowledge of the real cost of transportation by horse and wagon. The following table shows the cost of moving a load of one ton a distance of one mile on level roadways, with different pavements and under average conditions:

	Per ton-mile
Iron Rails	$ 1.28
Asphalt	2.70
Stone, paving, dry and in good order	5.33
Stone, paving, ordinary condition	12.00
Stone, paving, covered with mud	21.30
Broken stone, dry and in good order	8.00
Broken stone, moist and in good order	10.30
Broken stone, ordinary condition	11.90
Broken stone, covered with mud	14.30
Broken stone, ruts and mud	26.00
Earth, dry and hard	18.00
Earth, ruts and mud	39.00
Gravel, loose	51.60
Gravel, compacted	12.80
Plank, good condition	8.80
Sand, wet	32.60
Sand, dry	64.00

From the foregoing table, and from statistics gathered by both state and national bureaus, it has been calculated that the average cost of transportation by animal power is twenty-five cents per ton per mile. Furthermore, the rate of transportation by animal power is, and always has been, excessively high, and the evidence of statistics shows but slight improvement as compared with the progress made in other departments of industry, and by other means of transportation.

One fact is patent to all, that whereas formerly the distribution of population was approximately equal over the face of

the country, it is gradually becoming concentrated into large cities to such an extent that already fully one-half of the inhabitants of the older sections of the country live in cities. The evident reason for this is competition, the demand for increased output at reduced cost. Concentration indicates increased power for production. Take, for instance, some of our commonest staples, like wheat, beef, pork, molasses, wagons, horseshoes, butter and clothing. Within the writer's memory, these articles were produced at homes, or in small shops and factories distributed, like the population, quite equally throughout the country at cross roads and villages, utilizing crude methods and operated by the old-fashioned treadmill or horse power, and overshot water wheels. The output of flour per man per day in those mills did not exceed ten barrels. At the great Winnipeg and Keewatin mills, and at Minneapolis, the milling business has been so concentrated that to-day the output per man exceeds 100 barrels and the cost of production is correspondingly reduced. But of what benefit to inaccessible property in the interior is this reduced cost of production, unless like facilities for transportation are afforded ?

The measure of benefit which any improvement in production in one community bears to another community, depends entirely upon the transportation facilities between the two places.

Concentration of population and production requires for the better equalization of supply, and price of materials and provisions, that such centres must be provided with commercial veins and arteries which shall quickly and cheaply transport or exchange urban and suburban passengers and commodities. While long haul rates of transportation by railroads and steamships have been wonderfully cheapened, there still remains a space of fifteen to twenty-five or even forty or fifty miles surrounding every commercial centre, which has never been covered by any cheap method of transportation. Such distances are beyond the possibility of cheap or efficient service by animal power, and the terminal charges and bulky plant required, precludes any possibility of much reduction in railroad tariffs. What we require therefore is a new system of transportation which shall be alike available for freight and passengers. The problem of handling exclusively passenger traffic is comparatively simple; indeed it has already been solved for those districts where the population is sufficiently dense to support steam or electric tramways requiring no other source of revenue. Experienced railroad men are unanimous, however, in agreeing that no road, whether steam or electric, will pay in a thinly settled district, unless assisted by a bonus or by the addition of freight traffic.

The latest development in the line of providing for goods traffic on electric tramways came to the writer's notice some months ago in the shape of a combination vehicle, so constructed as to be readily convertible for use upon any ordinary roadway or upon a railroad track. It can be shifted from one to the other without the necessity of reloading or rehandling the contents between points of shipment and destination. The wagon proper is patterned after the ordinary improved road wagon, modified, of course, for the special nature of the service contemplated. The running gears and springs are of standard construction, having a carrying capacity of from three to seven tons, depending upon the class of freight to be carried.

The rail truck is not materially different from the car truck in general use upon our electric railways, except that it is provided with special attachments for automatically gripping and supporting the wagon proper. It has cast steel segments or dogs, supported in place horizontally by heavy plate springs, and used for the purpose of engaging the axles of the road wagon as the truck approaches from either direction. As the truck is drawn forward on the level rail by the electric motor, the impact of the projecting dogs against the wagon axles also starts the wagon forward, and as the latter travels down the inclined switch track, the axles gradually settle into the notch provided in the cast iron journal frames.

The actual time required for unshipping the wagon from the truck for road use, and vice versa, is not more than would be required for coupling together cars in making up a train. The weight of the combined wagon and truck is sufficient to insure perfect rail traction and the proportion between carrying capacity and dead weight averages about the same as the ordinary freight car. By establishing a uniformity of dimensions and making the rail truck interchangeable, the wagons can be loaded either end on from either direction, and any number of rail wagons can be connected and moved in either direction as a train, by steam, electric or other motive power.

W. H. Browne said Mr. Bonner had submitted a conundrum. He took it as a suggestion that the railroads should lend their lines for the transmission of parcels free, and thus make unnecessary the aggregation of population in large cities. G. H. Hill, Montreal, said that while the scheme was, no doubt, an interesting one, it was open to question. It proposed to do away with the frequent handling of products and seemed beautiful up to the point where the car is sidetracked. But it means the lying idle of a certain amount of rolling stock, and it is a question whether the producer could not bring his stock down to a certain point where it could be taken up by the train. Then he loses the ownership of the material the moment it leaves his yard. Now the railway company is not going to do the work of a commission agent for nothing. The speaker had run over a number of suburban routes, noticeably that of Grimsby, where the system seems to give first-class results. They run through a most fertile country tenanted by large fruit growers and farmers, who all need a certain amount of power at all times—threshing, pumping, churning, and yet strange to say the suburban company will not even think of taking power from their circuits. In Manitoba and the North-West Territories he knew of a scheme which was being evolved by some engineers who figured out that the farmer of Manitoba, with the straw annually burnt up, could do all the work of his farm by electric power. The discussion was continued by A. A. Wright, J. J. Wright, L. De W. Magie, C. H. Wright and W. H. Browne. G. H. Hill moved and E. D. Ellis (Barrie), seconded a vote of thanks to Mr. Bonner. The president in tendering the vote remarked that before you could get the farmers to use power you must have some model establishment showing what can be done.

A telegram from John Murphy, on behalf of the Ottawa Electrical Association, was read, wishing the association a profitable and pleasant convention in the commercial metropolis of Canada.

In the evening, on invitation of the Montreal Park and Island Railway, the members enjoyed a trip around Mount Royal, where a good view of some of Montreal's handsome suburbs was obtained.

Wednesday, June 29th.

The first business of the day was the presentation of the Secretary's report, from which it appeared that there had been five committee meetings during the year ending 31st May last. At the first a Committee on Mileage and Transportation was appointed. At a later meeting committees on general arrangements and on papers, and the secretary was instructed to render accounts to members in arrear for fees and make drafts if amounts were not paid within reasonable time. At the meeting of May 25 nine persons were elected to membership and the resignation of ten members accepted. In the early part of this year a pamphlet setting forth the character and purposes of the association was prepared and printed under the direction of the Executive. About 800 copies of this have been judiciously distributed. Particulars of other important work are to be found in the report of the Committee on Legislation. Incidental reference was made to the recent formation of the Maritime Electrical Association, of which F. A. Bowman, of New Glasgow Electric Company, a member of the Executive of the Canadian Association, is the president, to promote electrical interests in the Province of Nova Scotia and New Brunswick. During last year death entered the ranks of the association and caused the loss of Charles Ernst, of Detroit, and Ross McKenzie, of Toronto. During the year there were dropped from the roll the names of 21 members, 12 active and 3 associate members having resigned; 2 having died and 4 having changed their place of residence without furnishing their new addresses. Since the 1st inst. 2 additional resignations have been received and the names of 13 members struck off the roll for non-payment of fees. Thus there have been removed from the membership list since last convention 36 names. During the same period there were added 68 active and 11 associate members—a total of 79, leaving the present total membership at 234. The Financial Report for June, 1897 to May, 1898 shows total receipts $790.82 including a balance at the bank of $410.57. Bringing the financial operations up to June 29, the total at credit of the asociation is $588.75. The report was adopted, and the secretary thanked for the care with which he had prepared it.

REPORT OF COMMITTEE ON LEGISLATION.

Your Committee beg leave to report that in pursuance of the motion passed at the last convention held at Niagara Falls, instructing your Committee to take up the matter of securing legislation in connection with the movement among municipalities in Ontario to enter upon electric light undertakings, in unfair competition with companies already in existence, your Committee held their first meeting at the close of the convention. At that meeting it was decided to procure an opinion from Donald Guthrie, Q.C., ex-M.P.P., of Guelph, and to retain him professionally on behalf of the Electrical Association in connection with the question. Various questions were submitted to Mr. Guthrie, and his opinion in answer to these questions was considered at a meeting of your Committee held in Toronto on the 9th of November.

A bill was prepared which came before the Municipal Committee of the Legislative Assembly on the 12th of January. Your Committee in preparation for the meeting, assembled in Toronto on the 11th, and also on the 12th, and attended the meeting of the Municipal Committee for the purpose of supporting the bill. The Committee had also the assistance of Z. Lash, Q.C., with Mr. Guthrie.

After discussion, those representing us consented to a suggestion of the Honorable A. S. Hardy, Chairman of the Municipal Committee, and other members of that Committee, to allow the matter to stand over for another year. The discussion, however, brought out the fact that there was really no sound answer to the principle of the proposed measure. It also evoked an expression of opinion from the leading men of both political parties to the effect that the underlying principle of the bill was just. The Municipal Committee thought that there was not proper time to consider how the bill would affect places where there were more than one existing plant, also places that derived or may derive power from points outside the municipality, also to consider the length of the life of an electric plant and other questions, and in the judgment of the Municipal Committee any bill dealing with the matter would require more ample public discussion and some modification. The action of your Committee and the discussion the question has received, has tended to bring into prominence the injustice of the present law. The necessity and propriety of some measure of relief may be considered now to be more generally admitted. The work thus inaugurated and which has attained a hopeful position, should not be discontinued. The present law of Ontario is inequitable towards lighting and power companies, because it permits a municipality, after it has given its sanction to the formation of such a company and has encouraged enterprising citizens to embark their capital in it for the purpose of supplying the municipality wtih light and power, to turn around and destroy, with public funds, and without public necessity or advantage, the value of the property of those citizens who were encouraged to invest their private means in the enterprise. What evidently struck the majority of the members of the Municipal Committee was that the proposed legislation was just and equitable because, while it did not prevent municipalities entering upon municipal supply of lighting if they so desired, it made provision for extending the existing law regarding water works to the case of lighting companies. This law is to the effect that where a municipality desires to supply water and there is an existing water company incorporated for the municipality, the council shall not levy any water rate until the council has, by by-law, fixed a price to offer for the works or stock of the company, nor until after thirty days have elapsed after notice of such price has been communicated to the company, without the company having accepted the same or having, under the provisions of the Municipal Act as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid or has been secured to the satisfaction of the company; the price to be determined by arbitration under the provisions of the Municipal Act. It will be observed that this provision in no way interferes with municipalities going into the supply of water. It simply provides that if they do enter upon such undertaking they are by this law bound first to try to buy at a fair price, or at a price to be fixed by arbitration, existing waterworks. No good reason can be advanced why this law should not be extended to lighting and power companies as well as to waterworks. It is eminently just, and it imposes no hardships on the municipalities; nay, rather, it benefits them, because it tends to extinguish rivalry to themselves, which rivalry might render municipal operation of these works unprofitable, and at all events it puts them in possession, at a fair valuation, of the very plant and material that they would have to purchase from other people if they are going into the business. The proposed legislation is in the public interest, because it will further encourage private citizens to invest their capital in extending and improving existing lighting and power works. It was generally acknowledged by the Municipal Committee that electric light companies as well as water companies have always come into existence with the consent, encouragement and approval of the municipality, which has granted the use of the streets, etc., for these works.

It ought to be mentioned that all the members of your committee paid their own traveling and other expenses in connection with attending the meetings. The movement amongst municipal corporations to enter into the lighting and power business in competition with those who had the courage to be pioneers is growing, and unless regulated in some way by the legislature, will result in the confiscation of a large amount of capital invested in the business, as witness the town of Barrie now preparing to put in a complete plant, including arc, incandescent and power services, to be paid for out of public funds, for the purpose of competing with and destroying the Barrie Company, a private and lawful enterprise.

In the course of the discussion S. Noxon, Ingersoll, expressed his sympathy with the work of the committee and said he believed there was an Act in Scotland providing against municipal confiscation. British law has wisely been taken as a precedent, and it might be so taken now. An electric light plant needed protection in this respect more than a waterworks plant, for the latter was of a permanent kind, while an electric light plant was subject to frequent change from the constant improvement going on, and a plant that is considered efficient now might soon become obsolete. In certain circumstances this might be an argument against us, but in other cases, as for instance, that at Barrie, where the municipality refused to treat at all, the cancellation of existing rights would be a double injustice to private ownership. E. D. Ellis, Barrie, referring to the case of his company, said they had been for two years without a contract with the town. The town authorities would not talk to them at all. His company wrote that they were anxious to be on a proper footing and would even sell out their plant at its proper value. The town told them to put in a tender along with other tenders they were calling for, which was not fair to the company, who protested that this was not fair, and offered to leave it to three competent men as arbitrators. The town would not arbitrate. Other towns were evidently watching the result of this case.

The president said he had followed this subject closely for some years and his experience had been that most people are anxious to reap where others have sown. The first bill provided against this in a way, but the committee were impressed with the conviction that these difficulties have to be openly discussed and fairly met. The committee did not feel inclined to go on with the bill that session but were urged on from various quarters, and a short bill was prepared with the idea of a larger measure in the future. The Hon. Mr. Hardy said he had no doubt that municipalities in the future would submit to arbitration. J. J. Wright, Toronto, said the strongest emphasis should be laid upon the point of arbitration. When a plant is purchased by arbitration it should be at its value, and it is worth as much to the municipality as to the private corporation. The separation of the public lighting from the private and commercial branches would mean ruin in many cases. He could not understand why the electric light industry should be singled out for so many attacks. There seems to be an exasperating glamor about electricity, probably owing to the superstition that there is lots of money in it. The chairman said people in small towns have a notion that a dynamo set up beside a water wheel will produce power for nothing. Mr. Wright—That is what they think in Toronto. Mr. Noxon thought the supply men were frequently to blame for encouraging municipalities in this course. Mr. Wright thought more harm was done by "half baked" dynamo tenders who pose as electricians than by the supply men. B. F. Reesor, Lindsay, said the Municipal Act of Ontario clearly stated that where a bonus is given to a town it shall not interfere with any existing interests, and he believed that taking this as a principle of law, if a test case were made where a municipality attempted to crowd out

a private company without arbitration, the highest courts would affirm the company's rights, even without a special act. The chairman said lighting companies do not get bonuses and free sites like many other industries, and that is one of the hardships of the situation. A. A. Wright, Renfrew, said it was a difficult subject. There were political enemies as well as electrical enemies. An eye should be kept on the electrical supply men, who by telling half the truth to municipal authorities do incalculable harm.

This led to a tilt between the electric supply men and other speakers in which the former said they were "out for business" just the same as the electric lighting men, and it sometimes naturally happens that they cross each others paths.

The following standing committees were then appointed:

Statistics.—J. A. Kammerer, Toronto; A. A. Wright, Renfrew; S. J. Parker, Owen Sound.

Meter Inspection.—A. A. Dion, Ottawa; E. E. Cary, St. Catharines; J. J. Wright, Toronto.

Legislation Committee.—John Yule, Guelph; C. B. Hunt, London; B. F. Reesor, Lindsay; J. J. Wright, Toronto; W. H. Comstock, Brockville; F. Pepler, Barrie; A. L. Breithaupt, Berlin; C. Berkeley Powell, Ottawa.

NEXT PLACE OF MEETING—HAMILTON.

A letter was read from the Cataract Power Company, of Hamilton, extending an invitation to the association to hold its next meeting there. This was heartily endorsed by several members from Hamilton, and on putting it to the meeting the invitation was unanimously accepted.

J. J. Wright proposed, seconded by B. F. Reesor, that the remuneration of the secretary be $125 per year.—Carried.

Geo. H. Hill, Montreal, drew attention to the need of proper inspection of electrical construction, and thought that the Fire Underwriters should provide a competent inspector. At present there was no uniformity in inspecting, and in Montreal electrical men never knew where they were. During the discussion Mr. Browne, of the Royal Electric Co., said his company had already solicited the Government to appoint a competent inspector, but so far without success, and the company had to formulate rules of its own, which were generally accepted. Ald. G. W. Sadler said the City Council were now codifying general rules for building, plumbing, etc., and he would be happy to co-operate with a committee of this association with a view to having a set of rules for electric wiring and fixtures incorporated in these new rules.

On motion of Mr. Wright, Toronto, a committee consisting of A. A. Dion, Ottawa; F. H. Badger, jr., Quebec; P. G. Gossler, Montreal, and Ald. G. W. Sadler, Montreal, was appointed to meet the Boards of Fire Underwriters, and deal with the question.

Dr. J. K. Johnstone, Inspector of Electric Lights, Toronto, then read a paper, entitled "Experiences of an Inspector," which was well received.

EXPERIENCES OF AN INSPECTOR.

BY J. K. JOHNSTONE, INSPECTOR OF ELECTRIC LIGHTS, TORONTO.

When honored by an invitation from the Executive to prepare a paper for the society, I was somewhat in doubt as to the choice of a subject. I wished to furnish something that might be of interest to you and at the same time to avoid any of the important branches of electrical science which might leave me liable to criticism from gentlemen so highly qualified; hence, with your kind permission, I will confine myself to giving you a few impressions as received in my capacity as inspector.

At the introduction of the government inspection of electric lighting, there were a few, as you may remember, opposed to the act, and I acknowledge that it was with some misgivings that I went forth on my duties. However, it is with pleasure that I can now recall every visit made to the electric light stations in my district, and in every instance have I not only been kindly received, but every suggestion of improvement offered by me has been acted upon immediately and with evident pleasure. I need not tell you that in not one instance have I found any attempt on the part of electric light companies to defraud their customers, although occasionally appealed to by consumers on that ground. An investigation usually resulted in discovering old lamps, too few lights for the space lit, wastefulness where a meter was in use, or some other fault in the power of the consumer to correct.

The persistence of many purchasers of electric light in clinging to old and useless lamps is a common source of annoyance to the companies and a difficult matter to overcome. The old lamp is often expected to give as brilliant a light as when first installed, and when unable to do so the charge is frequently made that the company supply a too low voltage. To please these grumblers, a mistake is sometimes made in endeavoring to supply a current sufficient to brighten these worn-out lamps, and this, too, at the expense of new lamps, whose brilliancy is thus deteriorated. As it is impossible to compel the purchase of new lamps, and as the companies are anxious to please their customers, I have suggested, when consulted, that new lamps should be supplied at their actual cost, thus throwing the blame on the consumers when their lights were poor, economising electric current and sparing new lamps.

The question as to the advisability of using meters, where practicable, can only be answered in their favor. By the employment of a meter a just system is accorded to manufacturer and consumer alike; the wasteful man is made to pay fairly for his neglect, while the careful and honest man is charged only for the light needed and current consumed. Under the flat rate system, it is not uncommon to see large shops brilliantly illuminated throughout the entire night. Managers tell me that it is difficult to introduce the meter where flat rates have been charged, but, despite the objections, many are making the change. The several types of dial registering meters which I have inspected are usually accurate, and I am told prove satisfactory as measuring instruments for either power or light.

A lack of uniformity in rates, both by meter and flat rate systems, has been a subject of complaint with some managers. There is evidently no remedy for this unless an arrangement can be arrived at by the manufacturers themselves and a standard charge agreed to.

In several towns in the district visited by me, a system of street lighting by incandescent lamps has been adopted. When properly arranged the appearance is quite pretty and the light well distributed.

In concluding, permit me to tell you that the managers and electricians I have met in my work are, without exception, kindly and intelligent men, and in this favorable opinion I am borne out by other inspectors with whom I have spoken upon the subject. It has been suggested to me that there may be some potent and subtle charm in the electric current which develops the best qualities in a man's character. Can this be so?

W. T. Bonner, Montreal, read his paper on the "Quimby Screw Pump," which has been crowded out of this issue.

Mr. Bowman's paper on "Methods of Illumination" was taken as read, and the paper promised by Mr. Hopkins on electricity in Rainy River was not received.

The afternoon was devoted to social features. The first event was the inspection of the Bell Telephone Co.'s new building, where L. B. Macfarlane, the genial general superintendent, had a staff of the company's employees, who took charge of the visitors in groups and explained the wonderful complexities of the great exchange room, one of the largest and most perfect telephone exchanges in the world. After this the Montreal Street Railway Co., which had provided special cars to bring them down here, conveyed the visitors to the company's great power house, where 8,000 horse-power was observed in operation, the new 4,000 h.p. engine—the largest in Canada—being particularly admired. Four big pleasure vans were in waiting for the company at the corner of McCord and Seminary streets, the distribution station of the Lachine Rapids Hydraulic and Land Company, and after inspecting this building the party were driven to the big power house at Lachine Rapids along the picturesque Lower Lachine Road. Dismounting here the visitors were first shown the sea of rapids that tumbled and roared beyond the embankment at the outer end of the power house, and then they were shown the long gallery of turbines, and four large generators in operation. These generators, which were built by the Canadian General Electric Co., have previously been described in The Canadian Engineer in connection with an account of the Lachine Company's works. The inspection over, the visitors were invited to a cold collation and liquid refreshments which were enjoyed very much. Senator Thibaudeau, president of the Royal Electric Co., in a few

graceful words, conveyed the thanks of the association to the company and said of Mr. Walbank, the general manager, that the longer he had known him the more he esteemed his genial qualities, and he trusted he would be rewarded with all the success his enterprise and foresight merited. Mr. Walbank, replying, thanked the honorable senator for the compliment paid him, which he valued the more coming as it did from the head of a rival company. [Senator Thibaudeau.—Say "elder sister."—Laughter.] Mr Walbank took occasion to correct a member who on the previous day, speaking of unremunerative schemes that supplied more power than was demanded, said this company had only two generators running and not paying. As a matter of fact there was only one generator at present running during the day when lights were not in use, but at night there were three dynamos running, and the company was quite satisfied with the prospects. The visit closed with three cheers for Mr. Walbank, and the visitors were driven to the head of the dam, where they arrived just in time to see the steamer Sovereign run the rapids. The party returned to the city by way of the "Glen" and Dorchester street, and were set down at the Windsor thoroughly pleased with the excursion. The refreshments and conveyances were supplied jointly by the Canadian General Electric Co., and the Lachine Rapids Co.

THE BANQUET.

The annual dinner, which took place at the Windsor on Wednesday evening, 29th, will be remembered as the most successful in the history of the association. President Yule made an excellent chairman and kept the business of the evening moving without any tedious hitches. The dinner itself did credit to the Windsor's well-known reputation. The cover of the programme had the association's monogram and maple leaf in gold, and the covers with menu and toast list were held together by covered copper wire. The menu was as follows:

MENU.

Long Distance Transmission.
Fire Island Cocktail—50,000 Volts.
Internal Resistance.
Cucumbers Radishes
Tomatoes, strain Insulators. Olives tripled Braided
Electric Juice.
Green Turtle, a la Water Rheostat,
Cream of Asparagus, a la Ozone.
Submarine.
Saguenay Salmon, a la Hello, Potatoes, Rachel.
Shunts.
Spring Lamb Cotelettes, Sweet Breads,
Carbon Trimmed,
Asparagus—"Arrester" Points.
Joints—"Soldered and Taped." Filets of Beef, Larded
Relays and Sounders, String Beans,
Boiled New Potatoes, Anchors,
Cauliflower, Asparagus, Sweet Peas.
Trolley off. Punch au Champagne.
Reconstruction.
Roast Philadelphia Capon, Plants, Lettuce and Tomato Salad.
Boosters.
Cabinet Pudding "sound proof,"
Gelee aux Oranges, "insulating compound."
Savarin aux Ananas, "vacuum light,"
Vanilla Ice Cream, "self cooler."
Sponge Cakes, "Leather Belting."
Dessert.
Fruits, "potential currents," Nuts and "wrenches."
Electric heater, Incandescence
Cafe Noir, Cigars.
Transfer. Ring off. Open Circuit. "30."

On the chairman's right sat Mayor Prefontaine, Ald. Sadler, Dr. W. H. Drummond, C. B. Powell, and on his left the Hon. Senator Thibaudeau, W. R. McLaughlin, L. B. McFarlane, D. A. Macdonald, W. H. Browne, C. B. Hunt and P. W. St. George. The others present were: J. A. Kammerer, Toronto; John Carroll, Montreal; Samuel Adams Chase, New York; P. G. Gossler, L. D. W. Magie, Wm. T. Bonner, W. E. Quimby, F. W. Fairman, J. C. McCormick, R. H. Bartholomew, Wm. Smyth and John J. York, Montreal; A. A. Wright, Renfrew, Ont.; C. H. Wright, Alex. Barrie, William B. Shaw and D. W. McLaren, Montreal; Andrew Sangster, Sherbrooke; Geo. C. Rough, T. W. Atkinson, H. J. Gardiner, R. Dobie, H. J. Fuller, James A, Baylis, P. H. Hart, Fred. S. Hickey and James H. Campbell, Montreal; A. M. Wickens, Toronto; J. F. H. Wyse, Brantford; V. B Coleman, Port Hope; E. J. Kyle, Kingston; H. A. Moore, Trenton; J. W. Campbell, J. S. M. Ridley and E. D. McCormack, Toronto; J. W. Pilcher, Montreal; M. B. Lovell, Coaticook; H. E. Allen, Waterloo, Que.; H. E. Channell, Stanstead; Chas. E. Taylor, Montreal, E. Craig, Montreal; Gordon J. Henderson, Hamilton; A. W. Staveley, P. H. Davidson and J. R. Meadcroft, Montreal; A L. Breithaupt, Berlin, Ont.; J. K. Johnstone, and J. J. Ashworth, Toronto; W. F. Dean, Thomas Rodger, D. S. Barton, Jas. Hunter, Charles D. Matthews, and H. C. Ross, Montreal; George D. Ellis, Barrie; W. Ahearn, jr., W. G. Bradley and Ed. J. O'Reilly, Ottawa; J. W. Martin, Hamilton; H. W. McLaren, Montreal; E. B. Biggar, J. J. Wright and A. B. Smith, Toronto; Fred Thompson, Montreal; Wm. McCaffrey and Walker G. Anderson, Toronto; J. W. Purcell, Walkerville; C. E. A. Carr, London, Ont.; C. L. Weeks, Toronto; J. R. Wilkes, J. E. Scott and James Kent, Montreal; D. A. Starr, Cornwall; Wm. Campbell, Montreal; C. Thomson, Ottawa; S. Noxon, Ingersoll; P. Morgan, B. F. Reesor, Thos. Sadler and D. McGibbon, Lindsay; G. A. Powell, St. Catharines; R. E. T. Pringle and F. H. Leonard, jr., Montreal; E. E. Cary, St. Catharines; M. P. Cochrane and W. E. Gower, Montreal; Geo. H. Hill, L. Rousseau, Montreal; W. R. Leet, Danville; C. H. Mortimer, Toronto; Henry B. Haigh, New York; L. Robinson and John T. Murphy, Montreal; Robt. Welsford, England; W. F. Simms, Kingston; R. Stanton Wright, Ernest J. Jenking and M. Rubenstein, Montreal· Geo. Black, Hamilton; W. F. McLaren, R. F. Morkill, W. J. Plews, L. A. Howland, J. Fleet and J. W. Morris, Montreal; F. A. Wunder, New York; J. A. Burns, Geo. E. Matthews and Edward Carter, Montreal; W. A. Johnson, Toronto; E. A. Wallberg and R. A. Ross, Montreal; H. G. McLaren, London, Eng.

After "the Queen" had been loyally drunk, the secretary read several letters of regret from absent friends and members, among which was one from F. C. Armstrong, who was then on his way to England, but who desired to assure the company that his thoughts would be with them this evening. Mr. Browne departed from the programme for a moment to propose the health of Mr. Armstrong and wish him prosperity in his new and important field of work, and the rousing enthusiasm with which the toast was received showed how many warm friends Mr. Armstrong had around these tables. "He's a Jolly Good Fellow," was at no time more heartily sung. The chairman then proposed "Electrical Montreal," and coupled with it the name of Mayor Prefontaine, who, he said, ought to be made an honorary member of this association, as His Worship was the projector and proprietor of an electric plant at Ste. Agathe.

The mayor, who was received with hearty enthusiasm, said he would have hesitated somewhat at responding to what was really the toast of the evening had it not been that to some extent he was connected with the electric service. The importance of electricity among the sciences was apparent to all, and it was gratifying to him that so many French names, such for instance, as Ampere, were written in the history of that science. Referring more particularly to Montreal he ventured to say that this city with its population of over 300,000, including suburbs, had made a record that would compare with any city in the world. The pioneer company in Montreal was the Royal Electric Company, which began in 1884 with a dynamo of 12 arc lights capacity and a dozen employees, with a capital of less than $50,000 To-day this company was serving from its two generating stations electric current for 1,500 arc lights, 75,000 incandescent lights, besides 2,000 h.p. in motors. Its new factory has an area of 40,000 square feet, it has over 5,000 employees, and a capital of $2,500,000. In July, 1886, the city gave an order for 133 arc lights for street lighting, which was considered a big contract then, but to-day the city has nearly 1,500 arc lights. One of the latest contracts of the Royal Electric Company is to supply current to the Dominion Cotton Mills Co., to the extent of 1,500 h.p. to operate their large cotton mills in Montreal. The Chambly Manufacturing Company, by which current will be transmitted from the Richelieu River to Montreal by September next, represents a development of 20,000 h.p. He was one of the original promoters of this company, having got its charter through the legislature, and so foolish was the scheme considered that his action in the matter was put down to a desire to win a few votes at the next election. But now this great power is practically ready for trans-

mission. Another enterprise which was a credit to Montreal was the Lachine Hydraulic Works; with a capital of nearly $2,500,000, which has harnessed the St. Lawrence. The enterprise was a vast one. It might not be the complete success at the present time which its promoters expected, but that it would ultimately be a success no one doubted; and it would be a credit not only to the city, but to the gentlemen who had carried out such a big enterprise. In 1892 the Street Railway began operations by electric power, which was first generated at the power house of the Royal Electric Company, with two dynamos of about 500 horse-power; to-day it had 80 miles of track and a plant of about 10,000 horse-power, including an engine built by the Laurie Engine Company, of about 4,000 h.p., one of the largest steam engines in use. In 1894 the Montreal Park & Island Railway Company began operations, and to-day it was running to Back River, St. Laurent, Outremont, Cartierville, etc., and was operating about sixty cars. There were about 8,000 telephones in use in the city, exclusive of about 1,200 belonging to the Merchants' Telephone Company, so that the progress of electrical science in Montreal could easily be seen. He concluded by congratulating the association on the good work it was doing, and said he wished to become a member. The mayor was given three rousing cheers. J. R. Wilkes here sang "The Clang of the Forge," and was heartily encored. The toast of "Our Association" was followed by two comic songs from F. S. Hickey, who made himself a favorite at once. "Sister Associations" followed and R. H. Bartholomew sang "The Anchor's Weighed," and in reply to a hearty encore sang "Maid of Athens." "Our Guests" was replied to by Hon. Senator Thibaudeau, who in acknowledging the honor done him, said, the gentlemen he saw around were the representatives of what was most distinguished in the electrical world. It was to them that Canada owed its great strides in putting into operation the electrical force which had transformed all around us; it was to their energy that everything had been metamorphosed in the Dominion; it was to their accumulation of science that we had to-day those conveniences which contributed to the happiness of this nineteenth century, such as electric tramways, electrical power apparatus, telephones, the lighting so good and so brilliant that one could almost see his conscience better than he could with the "X" rays of the Christian teaching. Montreal had felt the magnetic impulse. The Lachine Hydraulic Works, which they had seen that afternoon in their grandeur, and the Chambly Works, which they would visit the next day, would tell them more about electrical progress in Montreal than he could. These works would tell them that the electricians of Montreal well deserved to be members of their association, and were a credit both to the association, and to the city of Montreal. The electricians of Montreal were jolly good fellows; they might ground a wire now and then, but they were seldom grounded themselves. (Laughter and applause). They also had their periods of incandescence, but it was with a good motive. In conclusion, he wished the Canadian Electrical Association and its members every success. Dr. Drummond was then called upon and gave the habitant's description of summer from his well-known book "The Habitant." At its conclusion there were clamorous calls for the "Pap'neau Gun" which was recited with fine effect. E. I. Jenking then gave a song, which was encored. The president proposed "Electrical Research," and coupled the toast with the name of W. H. Browne, who was not "general manager" tonight, but "one of the boys." Mr. Browne, who was received with "He's a Jolly Good Fellow," regretted the absence of Prof. Herdt, the able scientist of McGill, who was to have replied to the toast, but who was kept away by the serious illness of his wife. Disclaiming any pretensions to science himself he nevertheless spoke entertainingly of the advance of electricity within the past few years. It was only ten years ago that the first electric railway—a pioneer enterprise with which he was connected—began operations, while to-day there were 80 miles of track in this city alone. When hotels were being fitted up with electric curling irons in each room for the lady guests, what developments might we not expect in the near future. The farmer who now could grind his corn, chop his fodder, etc., by electricity, might soon be able to milk his cows electrically. Some one suggested that the day would come when we should eat, sleep, walk and talk electrically and man would thus become an automaton governed entirely by electricity —but, of course, we wished to defer that day as long as we could. (Laughter.) Messrs. Campbell and Starr then gave a duet which was well received and encored. "Allied Interests" was responded to by Ald. G. W. Sadler, of Sadler & Howarth, Montreal; E. E. Cary, of the Packard Electric Co., St. Catharines; C. Lord Weeks, Toronto, and Duncan Macdonald, superintendent of the Montreal Street Railway. Mr. Sadler referred to the fears of some manufacturers that their business would be wiped out when electricity came into general use, but to-day these lines of business are not only thriving but new lines have

WM. H. BROWNE, PRESIDENT CANADIAN ELECTRICAL ASSOCIATION.

been created, due to electrical development. He referred to the first electrical exhibition in Montreal, and suggested that exhibitions should be held in connection with future conventions. Mr. Weeks entertained the company with some humorisms, and Mr. Cary, who followed, showed how the evolution of electrical work in Canada had opened a field for specialists in manufacturing, and their success had shown that the progress of the country was steady and rapid. The three years he had spent in Canada were the happiest of the fourteen years in which he had been engaged in electrical work. Mr. Macdonald humorously sketched the difficulties of a street railway company. If anything goes wrong in the city the street railway is blamed. If the cars go too slow it is their fault, if they go too fast it is their fault all the same. Speaking of the progress of electricity he believed it would continue and perhaps be surpassed by the rising "generators." If our nearest ancestors could return from their graves and view the improvements and enjoy the blessings brought about by this science they would be astounded, and would lavish praise upon the electricians. In fact they can be called the Deweys of this generation. If the association returned with its convention to Montreal it would be greeted with a thousand welcomes. Mr. Kammerer was then called on and amused "the boys" with a funny story, after which Mr. Wilkes sang "Loch Lomond." "The Press" and the "Ladies" concluded the evening, the latter being replied to by Dr. Drummond, who recited the heroic episode of Madelaine Vercheres. The company separated at 1.30 a. m.

Thursday, June 30th.

The first business of the morning was the election of officers, all except the new members of the Executive being returned by acclamation. Mr. Hunt was nominated for president but declined to stand. The result was as follows:

President—W. H. Browne, general manager Royal Electric Co., Montreal.

First Vice-President—H. P. Dwight, president and general manager Great North-Western Telegraph Company, Toronto.

Second Vice-President—A. A. Dion, Ottawa Electric Co., Ottawa.

Secretary-Treasurer—C. H. Mortimer, Toronto.

Committee—J. J. Wright, Toronto; John Carroll, Montreal; O. Higman, Ottawa; A. B. Smith, Toronto; Wm. Thompson, Montreal; W. McLea Walbank, Montreal; E. E. Cary, St. Catharines; Gordon J. Henderson, Hamilton; H. R. Leyden, Hamilton; George Black, Hamilton.

On moving the new president into the chair the thanks of the association were tendered to ex-President Yule, whose urbanity, tireless industry and sound common sense had done so much to advance the association in public estimation during the two years in which he had held office. A hearty vote of thanks was also passed to the members of the local committee and to the various companies who had shown their hospitality on such a munificent scale. The members then went to visit the electrical and mechanical departments of McGill University, where the numerous electrical machines and delicately adjusted instruments were explained by Prof. Herdt with a lucidity that greatly impressed the visitors. The inspection was concluded by a visit to the physics buildings, where an interesting demonstration of X-rays phenomena was given by Mr. King.

The afternoon was taken up with a visit to the extensive works of the Royal Electric Co., where among a multitude of other work in process of manufacture the visitors saw parts of the big generator now being made for the Cataract Power Co., of Hamilton. From here the company went to Bonaventure station where a special G. T. R. train of four cars was in waiting to take them to Chambly, to see the works of the Chambly Manufacturing Company. Anticipating a large excursion the Chambly Manufacturing Company had requisitioned every vehicle in the town to convey the party from the station to the works. There were cabs and calashes, cabriolets and broughams, grocery wagons and butcher carts, market wagons and buckboards, in all conditions of repair and with all conceivable styles of upholstery. The cavalcade was greeted with cheers and the attack on Santiago was nothing to the storming of these vehicles. The scenery of the quaint old village of Chambly was much enjoyed, and so was the visit to the great dam and power house which have both been described in recent numbers of The Canadian Engineer. The venerable but still active president of the company, S. T. Willett, who has been elected mayor of Chambly continuously since 1873, was present to welcome the visitors, and did it with the sincerity so characteristic of him. After being photographed in a group the visitors were called into the upper story of the power house and beheld a table of interminable length spread with immense dishes of cold meats, confectionery, strawberries and cream, lemonade, claret cups, etc. To say that "full justice" was done to these provisions would be putting it mildly. Mr. Willett, who occupied the chair, welcomed the members and their ladies, and credited the electrical science with the transformation which was now being made in the town and its prospects. Hon. Senator Thibaudeau made a short speech of welcome which was well received, especially by the ladies whom he complimented with a gallantry so natural to a French Canadian. Mr. Browne followed with a few words of welcome on behalf of the Royal Electric Co., referring to the fact that beneath their feet the Chambly Co. had harnessed 20,000 h.p. where the shallows of a river had been running to waste for ages past. On behalf of the association Mr. Dion thanked the company for the handsome entertainment and excursion, which the members enjoyed, and the party returned to the city delighted with their trip, which formed such a pleasant finale to the convention.

A. A. Dion, 2nd vice-president Canadian Electrical Association, was born and educated in the city of Quebec. He commenced his electrical career in the service of the old Dominion Telegraph Co., in 1876. After filling various positions and engaging in railway work for a few years, he was appointed electrician for the Intercolonial Railway system of Canada in 1889. He resigned in 1891 to take the superintendency of the Chaudiere Electric Light & Power Co., of Ottawa, a position which he filled until 1894, when the amalgamation of the three

A. A. DION.

lighting companies doing business in Ottawa took place, when he was made general superintendent of the amalgamated companies known as the Ottawa Electric Company, which position he now holds. Mr. Dion was a member of the Executive Committee of the Canadian Electrical Association for 1897-98. He is a member of the American Institute of Electrical Engineers.

CONVENTION NOTES.

Taken as a whole the convention was the most successful in the history of the association. About 50 new members were elected, chiefly from Montreal and vicinity, and these were not drummed up, but were men who came in from a natural interest in the work of the association.

Secretary Mortimer had a good deal of work to do and got through it very creditably. Mr. Mortimer has one good quality among others, and that is he never fails in civility and courtesy.

The Packard Electric Co., of St. Catharines, kept open house at rooms 11 and 12 in the Windsor, and all were made royally welcome. Their Montreal branch was illuminated and the crowd of conventioners gave three cheers when they passed the place on one of their city trips.

Ald. Sadler's suggestion of an exhibition of electrical machinery in connection with the next convention was a good one, and is worth early discussion. The Packard Electric Co. made a little start on its own account by showing the sections of their new transformer and other goods in their rooms.

Mr. Kammerer gave the members a pretty souvenir in the shape of a little silk bow formed of the Union Jack on one side and the Stars and Stripes on the other. In bestowing it Mr. Kammerer did not forget the ladies. He never does.

"These gentlemen," said The Witness in one of its notes, "are adepts at 'stringing wires,' but it is pleasing to note that they do not—at least at association meetings—go in for 'pulling wires,' for official positions are filled with a view to the advantage of the association.

Among the American visitors was F. A. Wunder, of the New York office of the Fort Wayne Electric corporation. Mr. Wunder was pleased with what he saw in and around Montreal, and is generously leaving a memento of his visit in the shape of one of the company's Watt-hour meters, which will be presented to McGill University. Reference will be made to this in The Canadian Engineer. Besides Mr. Wunder, Mr. Quimby, the inventor of the Quimby screw pump, and Mr. McLaughlin, of The Electrical World, were present from over the border.

Too much praise cannot be given to the individuals who formed the Entertainment Committee and the companies who so liberally contributed their work and money to aid them. It is only another good illustration of the saying that when Montreal men undertake a thing of this kind they do it well.

The Canadian General Electric Co. had what the boys called a very "nifty" idea in the form of a nickel-plated model of a C. G. E. motor to be used as a paper-weight. It was much appreciated by members as a souvenir.

Among the many attractive points in Montreal during the convention, that of John Murphy & Co.'s store, where John Forman made an exhibit of the Upton Midget Enclosed Arc Lamps, held the attention of the delegates probably

as much as anything they had seen. This shop has lately had installed a large number of these lamps, having discarded their old style of arc lighting, and in some places done away with the Auer Incandescent Gas Light, and arranged to have the whole establishment lit with the Upton Midget Enclosed Arc Lamp. After a very careful test of the various lamps of different manufacture in the market, they concluded that the Upton was by far the most economical system of lighting to be had. This store, which is situated on St. Catharine street, (Montreal's principal thoroughfare), has fitted in the fourteen large windows fourteen of the Upton lamps, each arranged with a special bell mouthed shade, and though these lamps are taking but 4½ amperes on 100-volt circuit, the illumination far surpasses some of the window lighting on the same street where ten and fifteen incandescent lamps are used in handsome reflectors on 52 volt circuit, where each lamp would be drawing 1 ampere. In the case of the incandescent, 15 lamps would be drawing 15 amperes of current and giving 240 candle-power, while with one-third of the amount of current on the Upton Midget, the latter were giving 800 candle power, or practically three times as much. Not the least important point in this installation was the fact that the lamps which were ordered from John Forman, 644 Craig street, Montreal, on Wednesday the 22nd, were ordered on from the States, while handsome fixtures were being manufactured in Montreal for the installation, and the whole was in satisfactory working condition on Monday the 27th.

LAUNCH OF THE TORONTO.

Every circumstance favored the ceremony of launching the new Richelieu & Ontario Navigation Co.'s steamer "Toronto," which took place from the shipyards of the Bertram Engine Works Co., on the afternoon of June 21st. A clear, bright day, with a westerly breeze, brought out dozens of sailing craft and row boats, as well as some steam yachts, to view the first floating of the finest steamer ever built in Toronto. The decks of the steamer "White Star" were crowded with citizens who had come at the invitation of the Bertram Co., to view the launching, and about four o'clock the steamer lay to at the inner end of the Eastern Gap, opposite the shipyard where the new vessel stood braced up from stem to stern as if conscious of the impending event and eager to make the plunge. The supports having been knocked away, Madame Forget, wife of Senator Forget, president of the R. & O. Nav. Co., broke a bottle of wine on the bows of the new boat, christening her the "Toronto." A. Angstrom, constructing engineer and designer of the boat gave the command "let go," and when the last block was knocked away the handsome vessel, gay with

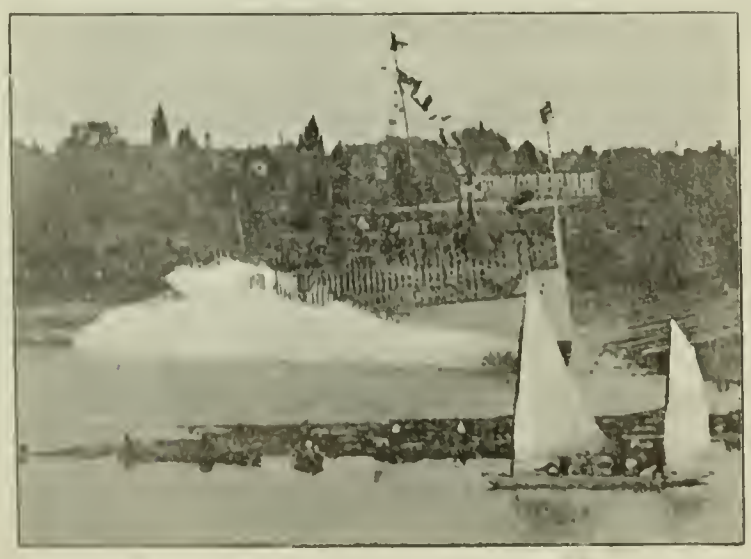


Photo by N. T. Maclaurin, amateur.

THE "TORONTO."

flags and streamers, slipped gracefully down the ways, dropped into the water with a lurch that sent the spray into the air in a vast cloud, and then she bounded upward "as a steed that knows his rider," shaking the water from her decks like a duck and then settled with a buoyant air on her native element. The large crowd upon the docks and on the steamers and boats set up a cheer at the neatness of the performance and the pretty outlines of the boat, while the band on the "White Star" played "Britannia Rules the Waves." The "White Star" then drew off into the bay, where congratulatory speeches were delivered, J. K. Osborne, one of the western directors of the Richelieu Co., presiding. Among the speakers were Sir Oliver Mowat, Senator Forget, Col. Henshaw, Mayor Shaw and Geo. H. Bertram, M. P. C. F. Gildersleeve, the general manager of the Richelieu Co., was present at the function. The company was entertained at a champagne luncheon by Mr. Bertram.

The new steamer, which will probably be ready for "sea" some time in September, will cost $240,000 exclusive of furniture and fittings, or about $275,000 in all, is guaranteed to make an average speed of 17 miles per hour on regular trips, but her estimated power will give 20 miles per hour when pushed. The following is a brief description of her:

The hull, constructed of open hearth steel, and of the following dimensions: Length over-all, 278 feet; length keel, 270 feet; beam, moulded, 36 feet; beam, over-guards, 62 feet; depth, moulded, 14 feet. The engines are of the triple expansion, inclined jet condensing type; cylinders, 28, 44 and 74 inches by 72 inch stroke. The feathering paddle wheels are 22 feet outside diameter, and 10 feet 3 inch face of bucket. The air and feed pumps are attached to and worked from main engine. The boilers are four in number and are of the return tubular type, 11 feet diameter, and 11 feet 6 inches long over heads. Each boiler has two 41½ inch outside diameter Monsom suspension furnaces. The boilers are fitted with the Howden Hot Draft, and are designed for a working pressure of 176 pounds. Spacious and elegant passenger accommodations are provided, one hundred and forty staterooms, including four parlor rooms and large Pullman sleeping cabin, furnish sleeping accommodation for 430 passengers. The dining room, placed on the upper deck, has a seating capacity for over a hundred persons. The interior finish and decorations of the spacious halls and deck saloons, are most elaborately executed, the main and gallery saloons being finished in Francis I. Renaissance style, with the dining rooms in Louis XVI. The entrance hall is decorated in Neo Grec, with modern Renaissance details, with the smoking room in Oriental treatment. The refreshment and writing rooms will be in Elizabethan panelling of prima-vera, natural wood finish. The main staircases are Honduras mahogany, with wrought metal balustrades, in hammered leaf work, finished in antique bronze, the main newels carrying bronze figures supporting electric torches. A 700-light electric light plant, with ornamental electroliers, in cabins furnishes light throughout the steamer.

ROPE DRIVING.

The subject of rope driving has so far received little or no attention at the hands of our Canadian engineering journals, in fact, we may safely say, that even in the United States, this is a subject touched upon very sparingly by the trade papers, and mechanical publications generally. We fancy the reason of this is that rope driving is a branch of mechanics not so generally taken up by the ordinary run of engineers and machinists, but is as yet more of a specialty, and has so far only been advocated strongly or to any extent by one Canadian firm, the Dodge Company, of Toronto. We believe that rope driving has a field of its own, and is not necessarily a competitor of the belt manufacturers as has been supposed. We have called at the office of the Dodge Co., Toronto, and have learned the particulars of a very interesting piece of work recently completed at the works of the Globe File Mfg. Co., Port Hope, Ont., by the Dodge Co., Toronto. In this instance the power of three 40" Leffel water wheels, under a 12' head, had been transmitted to the line shafts in shops, by means of bevel gears and crown wheels, on ends of upright shafts from water wheels—power taken from each wheel being about 40 h.p. In one case there were used a pair of bevel gears to carry the power of one of the wheels to a shaft at right angles to the others. In all three upright shafts there was a continual trouble in keeping them in line, owing to the great strain on their upper end, also in the case of the geared shaft at right angles, there was a continual jam either against the boxes, or the pinion on crown gears, thus consuming too large a percentage of the power. The crown wheel on No. 1 shaft had to be re-toothed as often as every two weeks, on No. 3 shaft every three months, and on No. 2 shaft two or three times a year, so that on the whole the power was unsteady, and much time was lost in re-toothing wheels and keeping them in proper alignment. In addition to this the noise from the gears was deafening, and the dirt from oil

dropping, etc., created a nuisance. With a view of a remedy the Globe File Co. therefore consulted the Dodge Co., and after the latter company's engineer had made a thorough inspection of the plant, a plan was devised to dispose of all the gears, and to transmit the power of the three wheels to the different line shafts by a system of rope transmission. The Dodge Co.'s men made the change and started up under the new rig without a hitch.

As to how the change has suited the Globe File Co., the Dodge Co. has shown us a copy of a letter recently received by them from F. Outram, the manager, he says: "As regards the three rope drivers you put in for us, they are working to our entire satisfaction. We know we are saving considerable power, besides doing away with the noise and rattle and wearing out of wood and iron gears—and it is ever so much cleaner. We would not change back for five times what the change cost us."

Yours truly,
Globe File Mfg. Co.

This letter goes to show that there are many instances to which the rope drive is particularly suited.

There are two systems of rope driving, i.e., what is known as the "American" or single continuous rope with an automatic take up or tightener, and the "English" system, which is a series of independent ropes. The former is the system advocated by the Dodge Co. We understand that some of our largest plants in Canada are run altogether by ropes, and they are found to be economical. The E. B. Eddy Co., of Hull, Quebec, is a great believer in the rope drive, and has several thousand horse power in daily use, installed by this company.

For THE CANADIAN ENGINEER.

FUTURE OF MECHANICAL TRACTION.

As to the future of the autocar industry, space does not permit of more than the briefest summary. The problem of transportation is the largest and most pressing in Canada to-day; whether we view the matter from the standpoint of convenience, speed, good roads or expenditure, the autocar looms up as a most important factor in the problem. Let us summarize a few facts.

The average cost of transport to-day of goods between Liverpool and Manchester, a distance of 35 miles, is over $2.25 per ton, the quantities to be conveyed being at least 15,000 tons per week. There are railways and there is the new and magnificent canal, and yet shippers demand a better and cheaper means of transport; for it must be remembered that although the rates must be high on account of the enormous capital account, both by water and rail, the carrying is not terminal, and three or four trans-shipments are involved in every bale of goods. By a light railway system, which would be inexpensive, compared with the ordinary railway and canal, motor wagons might utilize rails for the greater distance and run off the rail on to ordinary roads at the termini; the goods thus being handled only at each end when being loaded and unloaded, and a large item in the cost thereby saved. With all that can be done by railways or tramways, there are millions of tons of passengers and goods to be provided for between railway stations and destinations. Worby Beaumont, president of the Society of Engineers, points out that "it is not generally known that to-day it costs more to send a ton of goods by rail between some places in this country (England), than it cost formerly to send it by horse on the common roads. . . . The cost of haulage by rail is very small, but the terminal cost and cost of railway establishments, as vast machines, are so heavy, that the cheapness of railway transit disappears." He also points out that the British post office finds it cheaper to send its parcels by road than to pay the rates demanded by the railway companies for that traffic. When the comparatively small cost of autocar and motor wagon equipment for passenger and freight purposes is compared with the immense initial cost of railways, ordinary tramways, and canals, it will be seen that just as surely as the horse-cars have given place to the trolley, so surely must the heavy and expensive cars and rails, with the enormous funds required for maintenance, interest charges, etc., give way to the lighter, cheaper, and easily adaptable system of autocars.

In large cities, such as London, the question of space is another important factor. As Mr. Beaumont points out, there is such a density of traffic in London that nothing but the short-distance passenger accommodation must be allowed in the streets, either by tramcar or omnibus. "As early as possible," he says, "the motor cabs and omnibuses must displace horses so as to save the space now occupied by them, and avoid the pounding to pieces of the wood, asphalt and other of the best pavements with the 300-weight hammers of iron-shod horses' feet." He reckons that at least one-third of the space now occupied by the horses can be saved by the employment of motor vehicles. Some idea can be gathered of the pressure on London streets when it is remembered that every 24 hours

	Persons.		Vehicles.
Blackfriars Bridge discharges	69,838	and	8,287
London Bridge discharges	107,421	and	14,367

Then the cost of horses is in itself a very large item. Mr. Beaumont gives a calculation in which he shows that in Great Britain there are at present about 1,200,000 draught horses employed; but assuming that only 500,000 are at work, taking only the cost of keeping these horses, and saying nothing of the destruction to roads, the improvements in the roads which he recommends would result in a saving of £30 per year per horse, or a total of £5,100,000, which capitalized at three per cent. represents £170,000,000 sterling. He argues, "There is no doubt that such a sum might profitably be invested in the roads of Great Britain if we consider the advantages to be derived from mechanical traction."

The solution of the question of transport between towns does not necessarily lie in the direction of street railways or tramways, which Mr. Beaumont emphatically pronounces, "metallic admissions by engineers to the public of the badness of the ordinary roads." He adds that in the future of good roads, "Tram-rails in our streets will be considered nuisances not to be tolerated;" and "the days of toleration only wait for those mechanical road vehicles to prove plentiful as well as successful."

There is no reason, indeed, why the motor wagon enthusiasts should not carry their war into Africa, if they can only get engines with sufficient power; for the power directly applied to the driving wheels of autocars, and the immense tractive power of good roads, as compared with rails, put railcars at a disadvantage, when it comes to the cost of equipment and running. With 6,000 h.p. developed at the power house of a street railway company, the cars can only get what tractive effort the wheels will give them on the line. This is the weak link in the chain. In the case of a snow drift, for example, a motor car with spiked wheels would be able to overcome the obstacle better than the strongest street car plough. With the cars coupled up as they are to-day, the front car is never doing satisfactory work, because it is insulated by the snow, and therefore not getting power. Every few feet it has to be drawn out by the other cars. In the case of motor cars on the roads, they could not be insulated, and a set of three autocars, if hitched together, could be made to develop a total of 60 horse-power steadily applied, with a tractive pull of three tons.

Another element in the discussion of mechanical traction is that of danger to life and limb. In Britain the newspapers make "scare-heads" over every item in reference to accidents to motor carriages and their occupants, but never use the "deadly parallel" in showing the relative danger of motors and horses. In England and France there have been three deaths in connection with motor vehicles—all caused by recklessness and carelessness. The following record of accidents and deaths from horses in the vicinity of Toronto alone during two months is far more appalling:

Killed:—April 9th, Wm. J. Fenton, dentist, Toronto, horse frightened by watering-cart; 16th, Chas. Ralston, farmer, Walkerton, horse frightened by bicycle; 17th, Edward Lee, farmer, London; 19th, Isaac Ferris, St. Mary's, horse frightened by train; 23rd, Thos. Robinson, Omemee. May 1st, Joseph Bailey, farmer, Walkerton; 8th, Dalton McCarthy, M.P., Toronto, horse frightened by sound of church organ; 25th, Anthony Hurley, farmer, Eastwood, horses frightened by railway train. Total number killed in two months—8. Injured:—April 4th, son of David Hastings, Blenheim, badly injured; 16th, son of Chas. Ralston injured (father killed as

above); May 1st, London omnibus party, several ladies hurt; same date son of Joseph Bailey injured (father killed as above). Total number injured, 7.

A closing word as to the present position of the industry. In France, the home of the autocar (or automobile, as it is called by the French), the industry is going forward rapidly. The principal makers, of whom there are only about four who stand out beyond the general trade, are overcrowded with orders, and some firms are refusing them. Panhard & Levassor, in a recent fortnight, booked $150,000 worth of orders. In Britain, while we write, the trials of mechanical vehicles for heavy traffic are taking place, and the War and Post Office departments are watching them with interest. The industry is slowly emerging from the disastrous stock-jobbing which characterized its early days, and is getting on a business footing. The successful journey of Mr. Sturmey, editor of The Autocar, from John O'Groat's to Land's End, has helped to popularize the autocar, as showing what it is capable of. In the United States, the movement is slower than anywhere else, largely, we presume on account of the bad roads. Col. Pope has been bravely spending money in experiments with electricity, but the Pope electrical carriage has not yet been brought into general use. The Duryea carriage, which won the Chicago Times-Herald race, and the $3,000 Cosmopolitan prize at New York, does not seem to have recovered from the dazing effects of success, for we hear and see little of it now, though it is being manufactured in Springfield, Mass. The Winton, of Cleveland, is being pushed with some energy, and the inventor offers to put up $1,000 on a race from Chicago to New York, but stipulates that competing carriages shall carry only two passengers—which looks as though the Winton lacked the essential element of power, as do the other American motors.

The most important recent event is the heavy autocar trials at Liverpool, May 24th—28th, of which we give a summary. As a result, Messrs. Thornycroft are pushing the erection of an extensive factory for autocar manufacturing, at Basingstroke, while the Liquid Fuel Engineering Co. is selecting extensive premises in the Midlands for works for 500 or 600 hands, who will be employed solely in constructing "Lifu" cars.

HEAVY CLASS (FIVE TONS MINIMUM)—ONE ENTRY.

1. Thornycroft Lorry.—Steam Carriage and Wagon Co., Ltd., Chiswick. 6 wheels. Load carried by rear pair of wheels on platform resting on turn-table fixed over the rear wheels of the front portion of the vehicle, allowing motion in two places, so that wheel base could accommodate itself to road inequalities. Speed 5 miles an hour. Available floor space, 110 sq. ft. Tare (English) 3 tons 19½ cwt. (light); with fuel and water, in running order, 4 tons 5 cwt. Underframe and wheels of steel; roller bearings. Heating surface of water tube boiler, 65 sq. ft. Grate area, 2½ sq. ft. Test pressure 350 lbs. per sq. in. Fuel, steam—coal or coke. Engine horizontal compound with cylinders 4 and 7 in. by 5 in. Condenser of small copper tubes brazed together on roof of driver's cab silences exhaust, and blow-off from safety valve. Gearing has two speeds, engine making 9 or 12 revolutions to one of driving wheels. Powerful screw-down hand brake fitted to tires of driving wheels, and independent steam brake with pressure of 2¼ tons acts on wheels of trailing body.

LIGHT CLASS (TWO TONS MINIMUM)—THREE ENTRIES.

1. Thornycroft Car.—Tare, 2 tons 19 cwt. light, in running order, with fuel and water, 3 tons, 4½ cwt. Speed 6 to 8 miles per hour. Boiler, engine and mechanical details same as above, but gearing gives ratio of 8 to 1 from engine to driving wheels.

2. Leyland Van.—Lancashire Steam Motor Co. Platform area 78 sq. ft. Boiler, fire-tube type, with 110 sq. ft. heating surface. Weight, per sq. ft. of surface, is 6 lbs. Working pressure 200 lbs., tested to 450 hydraulically. Steam, which can be raised to working pressure in 18 minutes, is generated by liquid fuel, supply regulated by pressure on boiler, making firing automatic. Condensers on roof of cab make it unnecessary to carry any great quantity of water. In full work burns 1¾ gals. of oil per hour, costing 3½d. per gal. Inside of boiler can be lifted out for cleaning without removing any steam fittings.

3. Lifu Lorry.—Liquid Fuel Engineering Co., Cowes. 16 ft. 2 in. long, 6 ft. 6 in. wide over hubs. Wheels have bronze hubs, fitted with large reservoirs for lubrication. Steering by a handle connected to pivoted axles. Engine compound reversible, runs at 600 revolutions for speed of 8 miles per hour, geared down from 8 to 1. Water-tube boiler, 80 sq. ft. heating surface, capable of making sufficient steam to supply an engine indicating 35 h.p., and will easily indicate 25 h.p. without forcing. Boiler tested to 500 lbs. hyd. pressure, and safety valve set for working pressure of 250 lbs. per sq. in. Supply of oil to patent Lifu burner is automatically regulated by steam pressure in boiler, and set to ease the fire down at 225 lbs. pressure. Regulation of speed by means of h.p. cylinder valve, but when extra power required, high pressure steam is let into the h.p. cylinder. Brakes by reversing, also by foot brake, by steel bands around large gears fastened to rear wheels. Sand boxes are provided for greasy roads, and worked from driver's seat. Two oil tanks of 20 gals. each. Two water tanks, one of 60 gals., under driver's seat, one of 75 gals. under platform, are filled by steam injector. Weight of vehicle, without fuel or water, 38½ cwt.; with full supply, 54 cwt.; speed, 8 miles per hour on fair roads when fully loaded, and can climb grades 1 in 10 at 4 miles per hour.

The cars were loaded up with bags of gravel, and in addition to the "crew" were two "official observers" on each car, while another set of "observers" were placed in charge of the depot. The judges were: Sir David Salmons, Boverton Redwood, F.R.S.E.; Prof. H. E. Hele-Shaw, LL.D., M.I.C.E.; S. B. Cottrell, M.I.C.E., and Henry H. West, M.I.C.E. The competition lasted two days, covering two routes of 40 miles each. Several petroleum-driven smaller vehicles, and a steam wagonette, occupied by interested spectators, accompanied the competitors. The Autocar, to which we are indebted for particulars, says: "The Thornycroft five-tonner led off at a trot, with the Lifu bringing up the rear and dashing away in fine style after the rest, its funnel swaying about. . . . .

One incident of the first day's run was the bursting of a tube in the boiler of the Thornycroft 2½-ton van. This occurred when about half the journey had been made, and was undoubtedly due to the tube getting stopped up; a fact probably to be attributed to oil getting mixed with the feed water. The van was going so well, running easily and lightly with its load, and performed so favorably in other respects that it is much to be regretted this mishap should have occurred. The Leyland lorry lost two tires; the Thornycroft six-wheeler was delayed half an hour by getting a wheel stuck. The arrivals at Liverpool were as follows: Lifu, 5 p.m.; Thornycroft, two-tonner, 8 p.m. The Leyland ran after getting its tires put right, but had one wheel go to pieces entirely, and could not get home. Engineering, the well-known London technical journal, says of the end of the first day's trial "The Thornycroft 5-ton load van got in very late indeed, owing to the tire coming off. This was most unfortunate, as the journey was very nearly completed, and the wagon had gone exceedingly well during the day."

The second day's trial resulted in the following order: Lifu, Thornycroft two-tonner, Leyland. The third day the Leyland did not start on account of damaged wheel. The large Thornycroft kept on slow speed all day, and came in about 11 p.m. The fan of the small Thornycroft got out of order near the finish, but she raced home under forced draught. The Lifu had been injured the previous day by a steam carriage running into her, but she pushed through and finished the day's work at 4.30 p.m. On the fourth and last day, the Thornycroft six-wheeler made the run without accident and finished at 11 p.m.; the Leyland came through in good time, as did the smaller Thornycroft. The Lifu stopped twice to take water, and reached home by 3.30 p.m.

WHY THEY SAW NOTHING.

The report of the Canadian Government expedition to Hudson Bay last year has now been published. As was anticipated by those who knew somewhat of the circumstances under which the "Diana" was sent on her mission, the report is as little favorable to the Hudson Bay route as is possible without expressing too conspicuous an animus. It was currently reported in Canada a few years back that the Dominion Government would not take steps to develop the short northern route until the Canadian Pacific had got a fair start. The C.P.R. has not only got on its legs now—it is pretty well dominating the country, and does not mean to have any opposition if it

can help it; and it has particularly set its face against the Hudson Bay route. It was very unfortunate, therefore, that the secretary to the expedition should have been a son of the secretary of the Canadian Pacific Railway, and that before starting on the expedition he should have had an "interview" with the president of the Canadian Pacific. It was even more unfortunate that Captain Wakeham—admirable sailor though he doubtless is—should have been chosen to command the expedition, as he was notoriously inexperienced in ice navigation, and, on his own confession in the report, this inexperience led him into difficulties which hindered his test passage through the strait.—From the London Saturday Review.

THE MASTER PLUMBERS' CONVENTION.

The convention headquarters was at the Hotel Victoria, Quebec. It opened June 29th, and at 10 o'clock a private meeting of the Executive Committee was held, composed of the following: Jos. Wright, Toronto, president; W. Smith, London, vice-president; W. M. Briggs, Montreal, treas.; W. Mansell, Toronto, financial and recording secretary; J. B. Fitzsimmons, Ontario; A. Picard, Quebec; T. Campbell, New Brunswick; G. A. Perrie, Nova Scotia; T. Stevenson, Manitoba, and Jos. Lamarche, Montreal. In the afternoon at 2.15 a general meeting of the convention took place, and at 8 o'clock the business meeting was continued. On Thursday morning all the members attending the convention were photographed in a group, and other business meetings continued till the evening, when a banquet was held at the Victoria, to which the leading civic authorities and architects of the city were invited. Friday morning a drive around the city and different points of interest was indulged in, and a reception tendered the delegates in the City Hall by His Worship, the Mayor of Quebec. On Friday an excursion was made to the shrine of Ste. Anne de Beaupre over the line of the Q. M. & C. R. R. and on returning a stop was made at Montmorency to allow the excursionists to see the Falls. The election of national officers resulted as follows: President, W. Smith, London; vice-pres., J. W. Harris, Montreal; treas., T. Meredith, Toronto; sec., W. Mansell, Toronto; executive committee, A. Fiddes, Toronto; Jos. Lamarche, Montreal; Thos. Campbell, St. John, N. B.; M. Day, Halifax. Provincial vice-presidents, John Highman, Ottawa, for Ontario; E. Lesperance, Montreal, for Quebec; J. Doody, St. John, for New Brunswick; G. A. Perrie, Halifax, for Nova Scotia; W. Stephenson, Winnipeg, for Manitoba; M. J. Barr, Vancouver, for British Columbia.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

At the annual meeting of Kingston branch, No. 10, C.A.S.E., last month, the following officers were elected for the current year: President, C. Asselstine; vice-president, R. Bajies; secretary, J. L. Orr; treasurer, C. Selby; doorkeeper, S. Donnelly; conductor, G. Barrance; trustees, F. Simmons, C. Blomly.

Montreal, No. 1, C.A.S.E., held its annual meeting on the last Monday in May, when the following officers were elected: President, Geo. Hunt; vice-president, Wm. Ware; second vice-president, J. G. Robertson; recording secretary, H. Wilson; financial secretary, H. Nuttall; corresponding secretary, P. McNaughton; treasurer, Thos. Ryan; doorkeeper, John Huntingdon; conductor, Thos. Naiden; trustees, John J. York, John Huntingdon, O. E. Granberg; delegates to convention, Messrs. Huntingdon and Ryan.

The Canadian Association of Stationary Engineers' Unity, No. 5, London, Ont., elected the following officers at the annual meeting: Duncan McKinley, president; W. Blythe, vice-president; G. B. Risler, treasurer; W. Allen, cor. sec.; W. Meaden, rec. sec.; James Harding, conductor; Henry Geldart, guard. The installation of officers was carried out in a very efficient manner by the past president, J. D. Campbell.

The following are the new officers of Toronto, No. 1, C.A.S.E.: President, C. Moseley; vice-president, H. E. Terry; rec. sec., J. W. Marr, Davisville, Ont.; financial sec, A. Slute; treas., S. Thompson; conductor, W. Clark; doorkeeper, J. Long; trustees, J. Huggett, W. Webb, J. Fox. The officers were installed by past president Jno. Fox.

The annual convention of the Canadian Association of Stationary Engineers will be held this year in Hamilton, Ont., beginning on Aug. 8th. A most instructive and entertaining programme is being prepared, and the delegates will certainly enjoy a visit to so important a manufacturing centre as Hamilton.

PATENTS TO CANADIANS.

Fetherstonhaugh & Co., Patent Solicitors, of Toronto and Montreal, furnish us with the following list of patents, relating to machinery or engineering, granted to Canadians in the following countries. Any further information may be readily obtained from them direct.

Canadian Patents.—Amalgamators, M. Cross; wire fence machine, A. H. Cook; apparatus for amalgamating and concentrating precious metals, H. H. Earns; apparatus for the production and storage of acetylene gas, R. F. Carter; water heaters, R. Rushton; hay presses, R. McLoad; swing and slide farm gates, J. Pratt; shaft attachments, N. Green, automatic running board and guard rail combined, on the top of freight cars, J. Carmichael; seed drill disc shoes, N. Stephenson; cradles, C. Gay; straw cutters, A. Johnston; drain ditching plough devices, W. Hawker; valves, C. H. Volmann, liquid fuel burners, C. M. Cookson; machine for weaving wire fence, J. Roch; section valve for automatic fire sprinklers, E. J. Phillip; fire escape, J. McNeil; earth boring augers, Z. Leroux; tension for the binding mechanism of harvester binders, T. H. King; brakes, A. Desbains.

American Patents.—Motor, T. A. Brennan; grappling-hook, T. David; sheet-metal vehicle-wheel tire, J. Jamieson; brake, A. Desbains; thawing apparatus, R. B. Ormiston; pulley, H. S. Pell; electromagnetic-switch railway, A. Norman; vessel and sail and rigging therefor, C. Twining.

WATERPROOF STONEWORK.

What was at first considered a doubtful experiment, viz., the use of coal tar as a means of rendering masonry impervious to water, especially in positions exposed to direct contact with the latter, has proved a practically valuable resort, says Paving and Municipal Engineering. Used as a coating for masonry, built up of very porous stone, tar renders it quite impervious even at a depth of some fifty feet of water, and, according to the opinion of those whose experience has been extensive with it, the article should be utilized in all public buildings, particularly those designed for the preservation of works of art, the dissolving action of water, even upon mortar of superior quality, being well known, and also the unfavorable effect of the exudation of water charged with lime salts from the mortar. Two different methods of using the tar are named, viz., in a boiling state in one or several layers, this being suitable for surfaces exposed to the air, or it may be made to flame up before using, this being appropriate to surfaces which have to be covered up. It is stated that when boiling coal tar is employed in three coats on masonry, the result is a black and very brilliant varnish, which perfectly resists the action of frost, water and sun, being likewise absolutely impervious; and the tendency of the black coating to absorb heat may be overcome by white-dusting the whole before the tar is quite dry.

ELECTRIC POWER AT SAULT STE. MARIE.

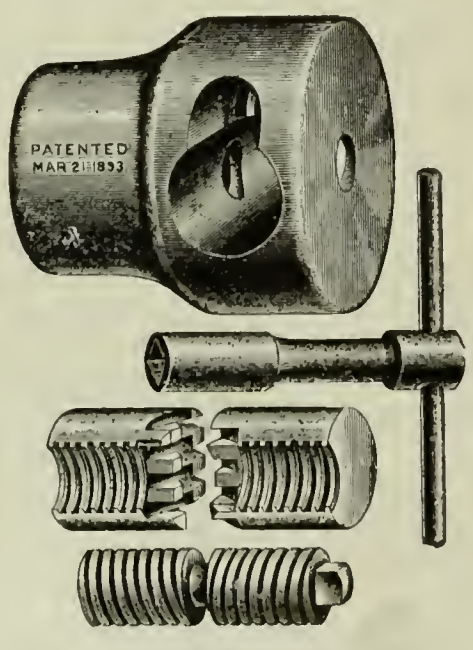
Great things are to be accomplished at the two "Soos," according to F. H. Clergue, president of the Lake Superior Power Company, at Sault Ste. Marie, Ont. Two hundred delegates of the North-West Electrical Convention visited the two towns a short time ago, and Mr. Clergue, addressing the delegates, said: "The Lake Superior Power Company have added to their present investment, the Power Canal at Sault Ste. Marie, Ont., by the purchase of the rights of the abandoned power canal on the American side of the rapids, and have added to the property thus acquired large tracts of land in addition, sufficient to permit of the construction of a hydraulic canal of about 50,000 horse-power. The plans for the construction of this canal have been completed, the specifications have been issued to contractors, and July 1st the tenders will be opened and the contracts awarded. The constructions provided for in the specifications consist of a hydraulic canal 22 feet in depth and 250 feet in width, terminating in a power station constructed of stone, and extending for a distance of

1,200 feet along the water front. This will be the largest hydraulic plant yet constructed, and will contain 80 electrical dynamos, of 500 horse-power each. The cost of this development will exceed $3,000,000, without including the cost of the mills and factories, which will utilize the power thus created. One-half of the entire power generated by the canal has been sold to the Union Carbide Company for a period of 25 years, and the remainder of the power will be devoted to metallurgical uses. The contracts call for the completion of all this work within three years from July 1st, and at its completion it is the intention of the Power Company to continue their operations by large additions to their works on the Canadian side."

Mr. Clergue explained that it was not the intention to begin the construction of a second water power canal on the Canadian side of the river until the end of the work on the American side of the river was completed, which would be in about three years. The new power canal on the Canadian side would have three times the capacity of the present canal, and it would cost about $500,000. The reduction works, which would be constructed at the Canadian Soo, immediately afterward, would not cost less than $1,000,000 more. After the canal and works were completed, the reduction works would give permanent employment to nearly 1,000 men, most of whom would be skilled workmen.

THE HORTON DRILL CHUCK.

As shown by the engraving, this chuck is simple in construction and very strong and durable in all its parts. The body is composed of one piece of metal and the entire chuck of four pieces. Chucks in ¼" and ½" sizes are made of steel, and in the larger sizes the working parts are of steel, the jaws are so constructed that there is no danger of breaking or crimping the drill by gripping as in many drill chucks. The right and left hand screw, which drives the jaws. is set deep



The Horton Drill Chuck

into the latter so that an end thrust with jaws is obtained and consequently a stronger grip with no danger of breaking the screw. The jaws are cylindrical and the power of the screw, being applied more direct, there is no binding or canting of the jaw when taking a short bite, as is the case with the 2 jaw chucks made with the old-fashioned, angular jaw set in a rectangular slotted body. This chuck is made in six sizes, as follows: ¼", ½", ¾", 1", 1½", 2' The 1½" and 2" sizes are attached to the spindle of the machine by means of a face-plate and screws, the same as an ordinary lathe chuck. These chucks may be had from the Aikenhead Hardware Co., 6 Adelaide St. East, Toronto.

TIDAL MOTORS.

Editor Canadian Engineer :

Sir,—An article under the heading "The old Tide Mills of Brooklyn," at page 371, of June 11th No. of the Scientific American for 1898, leads me to wonder how engineers are and have been striving after some ingenious automatic float arrangement for utilizing the force stored up in and to be had from the daily rise of tides in Canada and other parts of the world, when it would seem to be so much more simple to follow the practice of by-gone ages, by damming up the water as the Hollanders of yore did at Brooklyn. And if the practice paid there, where the tides, I believe, rise but a few feet, how much more prolific would they not be along the St. Lawrence below Three Rivers, where, as at Quebec, the neaps are 14 feet, and the springs as much as 22 or more; or again, in the Bay of Fundy, N.S., where the rise varies from 30 to 60 feet.

To get sufficient power from a float, it must evidently be of very large size, and therefore, the larger the more expensive; the price increasing as the area or square of its dimensions—while in the barring of a creek or ravine or mouth of a tidal river, the cost would be enhanced only in the ratio of the length of dam, the area of water enclosed increasing in almost any ratio. It would therefore seem that the simplest and most economical mode of utilizing the rise of the tide would be to proceed as in the impounding of water for an aqueduct; establishing all along the face of the dam a series of automatic gates, opening to the rising water and closing at ebb; when side issues from such a body and bearing only a relatively small proportion to the bulk of water held up, could be utilized either through turbines or undershot wheels for a variety of purposes.

Chas. Baillarge, C.E.

It is now about three years since the Syracuse Smelting Works first introduced their Syracuse babbitt metal into Canada. It has since been giving great satisfaction, so that they have been constantly asked by numbers of their large customers to start works in Canada. They have at last done so, and have established works on the corner of St. Thomas and William sts, opposite the street railway powerhouse, Montreal. With the two furnaces set up they are able to turn out four tons of babbitt metal per day. Finding that they cannot fill their orders on stereo, electro and linotype metal as well as solder they are now preparing to build one more furnace for making babbitt metal and one for solder and other metals. They have laid in a large stock of raw material, such as pig tin, pig lead, antimony, ingot copper, ingot brass, as well as scrap copper, scrap brass, aluminium and numerous other metals, so as to be able to supply all customers with everything in the line of metal that they may require. The business will continue to increase on account of the quality and price of the metals supplied by this company.

THE AMERICAN STOKER COMPANY.

We have been requested by the American Stoker Co. to publish the following letter:

Montreal, June 29, 1898.

The General Engineering Company of Ontario, Limited,
80 Canada Life Building,
Toronto, Ont.

Dear Sirs:—The American Stoker Company, having an office at room 54, Street Railway Chambers, Montreal, have submitted to us your circular letter, dated 26th of May, 1898, in which it is stated that the American Stoker now being introduced into Canada by the American Stoker Company, is an infringement on certain alleged Canadian patents owned by you, and that as soon as the American stoker is installed in Canada, your solicitors have been instructed to take proceedings in the Exchequer Court of Canada against the user as well as against the manufacturer and importer, and warning the public against the use of the American stoker. We are instructed by the American Stoker Company to inform you that the stokers manufactured by our clients are protected by Canadian patents and are not an infringement of any patents legally held by your company.

We are also instructed to inform you that the American stoker company have sold and delivered five stokers to the Dominion Cotton Mills Company, and are about making delivery of stokers to other purchasers in Canada, and are prepared to defend any action for infringement or damages which may be brought by your company in virtue of such sales for the use which may be made by the purchasers of these stokers, and we are authorized to accept service of any legal proceedings which you may bring against the American Stoker Company.

We have further to inform you that in the event of your Company not making good your threats contained in your

circular letter within fourteen days from this date, which are calculated to deter prospective users of the stokers from purchasing from our clients, we are instructed by the American Stoker Company to institute legal proceedings against you for damages, and for an injunction to restrain you from threatening legal proceedings on the ground of alleged infringement of patents. All other rights are reserved.

Your obedient servants,

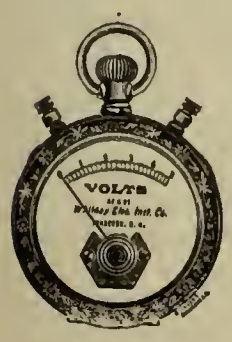
MACMASTER & MACLENNAN.

FIRES OF THE MONTH.

June 1st—The Union Abattoir Co.'s buildings, St. Henri, Montreal; loss about $150,000.——June 4th—Dixon & Gibbon's spice mill, Winnipeg; machinery destroyed.——June 4th—D. LaLiberte's foundry and machine shop, St. John's, Que.; loss about $3,000.——June 5th—S. R. Foster's pottery, Hamilton, Ont.; loss about $4,000; insurance, $2,700.——June 5th—A. Smith's stove mill, Fesserton, Ont., detroyed.——June 10th.—Jos. Bourque's planing mill, Hull, Que.; loss about $8,000. ——June 13th—Acton, Ont., Tanning Co.'s premises damaged to the extent of $500.——June 14th—John McCleary's saw mill, Bristol Ridge, Que.; total loss.——June 14th—Burley & Galligan's foundry and machine shop, Rat Portage, Ont.; loss, $25,000.——June 15th—The Sherbrooke Yarn Mills and C. E. Shedrick's, electrical instrument maker, Sherbrooke, Que; loss partially covered by insurance. C. F. Shedrick's business was continued at once.——June 18th—R. Arnott's cheese box factory, Peterborough, Ont.; destroyed; insurance, small.——June 19th—Oxbow, N. W. T., Milling Co.'s flour mills; no insurance.——June 19th—R. Sloate's saw mill, Tracey's Mills, N. B.; loss, $8,000.——June 21st—The Coleman Lumber Co.'s planing mill, Burlington, Ont.; loss about $10,000——June 23rd—Buck's Stove Works, Brantford, Ont.; pattern shop destroyed.——June 23rd—A. McDonald's saw mill, Peterborough, Ont.; insurance, $3,000.——June 24th—W. W. Doherty's saw mill, Campbelltown, N. B.; loss, $10,000; no insurance.——June 26th—Clifton Hotel, Niagara Falls, Ont., $60,000.——June 29—T. Ebbage's planing mill, Acton, Ont.; loss, about $700.——July 2nd—Court house and jail, St. Thomas, Ont.; loss, $50,000.——July 2nd—G. H. Harper & Co.'s flour mill, near Dundas, Ont.; loss, about $20,000.——July 5th—St. Bernard's convent, Antigonish, N. S.; loss, $25,000.

A POCKET VOLTMETER.

The Whitney Electrical Instrument Company, Penacook, N H., is manufacturing a line of pocket voltmeters and milammeters for continous current. They are made in the form of a watch, as will be seen from the accompanying illustration of the voltmeter.



This instrument has a range from zero to five volts, and was designed to meet a demand among battery users for a low reading and convenient voltmeter. The principle of construction is the same as that of the Whitney Company's standard portable voltmeters for direct current, and the instrument is built with the same care. It is accurately calibrated, and the scale is drawn in by hand. The works are mounted in a handsome silveroid case, which will remain bright indefinitely, and is about the same size as a gentleman's watch. With this pocket voltmeter, the operator of an electric vehicle, or the engineer of an electric launch, can quickly determine which of his accumulators are "dead" and cut them out, thereby getting the full benefit of the good cells.

☞ These instruments are being manufactured in Sherbrooke, Que., by C. E. Shedrick, whose catalogue also contains a large number of other interesting features.

STEAM VS. ELECTRICITY.

The report of James Milne, the expert employed by Toronto to make a report on the cost of an electric power supply for street lighting and commercial purposes has been made. Mr. Milne reports that the data received from the users of both electric and steam power is not to be absolutely relied on for the purposes of careful calculations, owing to the different bases upon which the various returns have been prepared. The summary of the steam users shows a consumption of 16,802 horse-power, from which 10,000 may be deducted for the Toronto Railway Company, Toronto Electric Light Company, Incandescent Light and Corporation plants, leaving 6,802 horse-power for commercial purposes. Of this amount he says, nearly 1,000 horse-power could be supplied by electric power or gas as cheaply as at present, but for the remaining 5,800 horse-power it is useless trying to persuade the manufacturers to change from their present methods, because some profess themselves well satisfied with the steam plants already installed; some use refuse for fuel, some require steam for heating, drying, etc., and others wish the source of their power to be independent. Mr. Milne also stated that in many businesses the cost of power was a very inconsiderable part of the expense of production, and the saving to be made by using electricity not sufficient to make the change desirable.

Railway Matters.

Truro, N.S., has voted a bonus of $30,000 to the Midland Railway.

The C.P.R. authorities have increased wages all around about ten per cent. to the trainmen in the Ottawa and Quebec division.

The Grand Trunk Railway has ordered ten hundred and fifty double-deck stock cars from the Michigan Peninsular Car Company.

The city of Brantford, Ont., is asking the G.T.R. to spend $7,000 in extending the bridge in connection with the proposed flood-prevention works.

The C.P.R. is making a large addition to the rolling stock at the Perth, Ont., workshops. There are 250 flat cars, 200 box cars, and 50 coal cars now in the course of construction there for use generally over the road.

The surveys have been completed on the Nelson and Bedlington Railway, which will give West Kootenay's mining centre of Nelson, B.C., direct communication with the United States, via Bedlington, a point near the Idaho boundary of British Columbia.

There are four parties in the field working the surveys for the new C.P.R. line north from Toronto. H. D. Lumsden is chief engineer, and the chiefs of the parties are Messrs. Brunel, Mitchell, Morris and C. B. Smith, whose districts are respectively French River to Sudbury, French River to Parry Sound, Parry Sound to Severn River, and Severn River to Kleinburg.

The C.P.R. is willing to spend $75,000 on yards and shops at Calgary, N.W.T., but object to the conditions which the council sought to attach to the $25,000 bonus. The conditions suggested by the council included the inspection of the company's time sheets and a forfeit if the C.P.R. shops moved from Calgary before 25 years.

The Windsor station of the C.P.R. at Montreal is to be enlarged by the addition, entailing the outlay of a quarter of a million dollars, or possibly more. The extension will be west on Osborne street, and will make the building twice its present size. It will be of the same material and in the same style, and when finished will make one of the most complete railway offices and depots on the continent.

It has been stated that the G.T.R. would shortly commence the construction of a line from a point on the Northern to the Sault. The line will run northwest, crossing the French River in the township of Mowat, and striking the Sault branch of the C.P.R. at Massey. The G.T.R. have running powers over portions of the road from Massey to the Sault. A good deal of grading and rock cutting was done some years ago on the line east of Massey.

The Robson-Penticton Railway has been surveyed to connect with the C. & W. at Robson, thence up the Lower Arrow Lake to Dog Creek; up this stream to McCrea Pass; thence down McCrea Creek and Christine Lake to Cascade City; along Kettle River to Grand Forks; up the north fork and Brown's Creek to Eholt Pass: down Eholt Creek to Boundary Creek, and through Greenwood, Anaconda and Boundary Falls to Midway. The route is 100 miles long and is filled with engineering problems.

The annual meeting of the Quebec Central Railway was held in London, England, on June 6th. It was reported that the gross earnings for the year ending December 31 last, amounted to $457,643, being an increase of $60,537 over those of the preceding year. The working expenses amounted to $309,555, being an increase of $40,761. The net earnings were $148,088, being an increase of $19,776, to which was added interest on balances, etc., $2,830, and there had been written off some items amounting to $2,954, making the available net revenue $147,964. After paying interest on the prior lien bonds, $85,166, there remained a balance of $62,798, out of which a dividend of one and one-half per cent. had been declared and paid on the income bonds, leaving $13,450 to be carried forward. The percentage of the working expenses was 67.64 per cent. as compared with 67.68 per cent. for the previous year.

It has been proposed that the Central Ontario Railway, from Picton to Coehill, be extended into the mining district.

The Alberta Railway and Coal Co. of Lethbridge, N.W.T., has ordered two more Munford Improved Boilers of 150 horse-power each from the Robb Engineering Co., Amherst, N.S.

The St. Hyacinthe and Granby Railway proposes building a bridge across the Yamaska and a passenger depot. The proprietors have petitioned the St. Hyacinthe, Que., council for a grant of $75,000.

The engineers in charge, Lauthier and O'Dwyer, have completed the final location of the Great Northern Railway, between Shawenegan and Montcalm, a distance of 53 miles, which completes the gap between the constructed sections of the railway.

Three hundred men have started work grading the right of way for the proposed railway from Skaguay to the lakes. The work is being done by the Pacific and Arctic R. & N. Co., of West Virginia, which is said to have secured the charter and holdings of the British Yukon Company.

The track-laying on the Ottawa and Montreal road, the new C P.R. short line, has been completed. All that now remains is to make the connection with the Canada Atlantic Railway tracks and complete the ballasting. Some 250 carloads are being deposited on the line every day. The bridge across the Rideau is completed and is being painted. All the stations along the line are ready for occupation.

Electric Flashes.

The town of Thorold will borrow $7 000 to extend the municipal lighting plant.

The Great Northwestern Telegraph Company has completed an extension of their line into British Columbia.

The Little Salmon River Telephone Company applies for an extension of its charter powers and it will then extend its lines.

E. I. Sifton has been appointed manager of the Electrical Construction Co., London, Ont., in place of S. R Break, who has gone to Arizona.

John R. Coffman, who for the past year has filled the position of superintendent for the London Electrical Construction Co., has returned to Detroit.

The Toronto Railway Company has placed an additional order for ten C G.E. 1,000 two motor equipments with the Canadian General Electric Company.

The Montreal Street Railway Company has erected a new brick blacksmith shop at Hochelaga, 75 by 58 feet; the building is also to be used for the company's repairing work.

The town of Acton, Ont., is contemplating the installation of a municipal electric lighting plant. The estimates were supplied to the council by Mr. R. J. Parke, consulting electrical engineer.

The Wm. Cane & Sons Mfg. Co., Ltd., of Newmarket, has placed an order with the Canadian General Electric Company for a 17½ kilowatt four-pole lighting generator and marble switchboard.

Ladies ran the street cars of Cornwall, Ont., on the 15th of June, and a percentage of the earnings of the road on that day, which were large, were given to the General Hospital and Hotel Dieu.

C. E. Shedrick, manufacturer of electrical measuring instruments, Sherbrooke, Que., suffered considerable damage from smoke and water when the Sherbrooke Yarn Mills were burnt down, June 15th.

R. Prefontaine, Ste. Agathe des Monts, Qne., has placed an order with the Canadian General Electric Company for a one thousand-light single phase standard ironclad armature type of alternating current generator.

The town of Listowel, Ont , is considering a by-law impowering the municipality to borrow $19,700 for waterworks and electric lighting. The plans and estimates for the work were prepared by John Galt, C.E , Toronto.

The Quebec electric railways and the Quebec, Montmorency and Charlevoix railways have been amalgamated and will have a working capital of $3,000,000. It is stated that the company will buy the Montmorency Falls outright.

The Shawenegan Water and Power Co., which has been incorporated to develope and utilize the water power at Shawenegan, Que., will not manufacture pulp at present, it has been decided, confining itself to the production of power. The incorporators of the company are David Russell, Montreal; John Joyce, Boston; William Strachan, Montreal, and others. Thos. Pringle, Montreal, has the work of development in hand.

The Berlin, Ont., Electric Light Co. has bought a 165-h p. boiler from a London, Ont., firm.

The Hamilton Electric Light and Power Company, Ltd., has placed an order with the Canadian General Electric Company for a 200-kilowatt 250-volt generator which they intend using on their power circuit.

The flow of the river Credit was recently measured by parties interested in electrical development in Toronto. It is hardly probable that the volume of water will be found sufficient to produce any very considerable power.

During May the Galt, Preston and Hespeler Street Railway handled 950 tons of freight, a slight increase over the corresponding month of last year, and carried 18,000 passengers, an increase of about 500 over May, 1897.

The first electric car traversed St. Thomas' streets June 15th. The electric street railway begun March 24 has been completed, and was opened for public travel on the 16th. The road is six miles in length and cost $80,000. The formal opening was held July 5th.

The Cornwall, Ont., Electric Street Railway Company, Ltd., in consequence of the increased demands on the freight service, has ordered another freight locomotive and has placed an order with the Canadian General Electric Company for the electrical equipment, consisting of four C.G.E. 1,200 motors.

The Pembroke Navigation Company has placed an order with the Canadian General Electric Company for equipping the steamer "Victoria" with a complete electric lighting plant, which will include a six-kilowatt standard Edison type dynamo, a vertical automatic engine and a search lamp of 4,000 candle power.

Judge McDougall has handed out judgment granting the motion to quash the indictment preferred at the December Sessions, 1897, against the Toronto and Mimico Railway Company, charging the latter with running their cars on Sunday, contrary to 60 Victoria, cap. 14 sec. 95, and sec. 138 of the Criminal Code. This allows the line to run Sunday cars.

The Canadian Pacific Railway, which has recently acquired the smelter at Trail, B.C., formerly operated by Aug. Heinze, has concluded negotiations with the West Kootenay Power and Light Co. for the supply of electric current to operate the smelter, and have ordered from the Canadian General Electric Co. two 75 k.w. three-phase revolving armature type synchronous motors, which will be operated at a potential of 550 volts. They have also ordered three 50-h.p. induction motors and three 30-h.p. induction motors which will also be operated at a potential of 550 volts.

The Lang Tanning Co., Berlin, Ont., has recently given an order to the Canadian General Electric Co. for a 100-k.w. multipolar direct current dynamo, which will be operated at a potential of 250 volts. This generator will supply current for the operation of two of the Canadian General Electric Co.'s latest type of multipolar direct current motors, each having a capacity of 50-h.p. and one 10-h.p. motor. The order given to the General Electric Co. also includes the installation of a marble panel switchboard, containing the necessary instruments for the operation of the plant and the wiring up of their factory.

A. E. Carr, superintendent of the London, Ont., Street Railway Company, has been appointed superintendent of the Montreal Park and Island Railway, in succession to A. J. Corriveau, who recently resigned. Mr. Carr still retains his position with the London company, and will, it is said, manage both jointly. When only sixteen Mr. Carr was secretary-treasurer of the sewer department at the Toronto city hall, and had after that experience as private secretary to H. A. Everett, formerly of the Toronto Railway Company. He was appointed to his present position in London in 1895.

The Carborundum Company, of Niagara Falls, has commenced the manufacture of its product in Canada under the patent which it holds. It has just built a new factory building at Niagara Falls, Ont., but the electrical apparatus not having arrived in time for the plant to be utilized in accordance with the patent provisions, in order to maintain its rights, the company, with considerable enterprise, erected a furnace in the power house of the Niagara Falls Park and River Railway Company and there made the first carborundum produced in the Dominion. Carborundum has been increasing in popularity, and the output on the New York side of Niagara has been materially increased. Now the company is erecting a three story brick building, 50 x 228 at the foundation, in which they will spread carborundum on cloth and paper, thus bringing carborundum in competition with the flint, garnet and other paper manufactures in the United States, of which, it is said, there are seven or eight. This new branch of the company's business is expected to reach large proportions, and it is expected that it will make necessary a still further increase of the carborundum producing plant. The president of the company is E. G. Acheson.

The Lakeport Preserving Co. has given an order for the installation of a lighting plant for its factory to the Canadian General Electric Co.

The Electric Co. of St. Johns, Nfld., is increasing its plant and has ordered a 150-h.p. tandem compound engine from the Robb Engineering Co., Amherst, N.S.

For the rebuilding of the retaining walls of its railway the Hamilton and Barton Incline Company has awarded the contract to Rowan & Elliott, of St. Catharines, Ont.

The Toronto Railway Co., which recently ordered a number of the Canadian General Electric Co.'s well-known type of C.G.E. 1,000-motors, has given an order for additional equipments.

The Strathroy, Ont., Electric Co., Ltd., has met with so much success that it has recently placed an order with the Canadian General Electric Co. for the installation of another 500-light single-phase alternator.

The Toronto Electric Light Co. has been ordered by the city council to extend its system to the Island at 20½ cents per light, as the Island is part of the city and the company's charter covers the whole city.

The R. Forbes Co., Ltd., Hespeler, Ont., has placed an order with the Canadian General Electric Co. for two 500-light Generators. These generators are to be supplied of the Canadian General Electric Co.'s latest four-pole type.

Hon. John Haggart, Perth, and others, have been incorporated under the name of "The Canadian Electric and Water Power Company," with a capital stock of $150,000, to produce and distribute electricity in Perth, as well as in other towns in Canada.

La Compagnie Manufacturiers et Electrique de Montmagny has given an order to the Canadian General Electric Co. for a 100-k.w. monocyclic generator, which will be operated at a potential of 2,080 volts, together with the necessary station instruments for the operation of the plant.

The West Kootenay Power and Light Co., who have just closed a contract with the C.P.R. authorities for the supply of electric current to operate their Trail smelter, have placed an order with the Canadian General Electric Co. for the supply of three 135-k.w. transformers of the well-known air blast sub-station type.

The Lachine Rapids Hydraulic and Land Co., of Montreal, has given an order to the Canadian General Electric Co. for the installation of a seven-panel power-house switchboard, which is to be built in accordance with specifications and drawings prepared by R R. Kelsch, superintendent for the Lachine Rapids Hydraulic and Land Co.

The citizens of Hamilton will vote on July 27th to decide the following questions about the street railway: 1. Shall the city purchase and operate the Hamilton Street Railway? 2. If the city does not now purchase the Hamilton Street Railway, should the council extend the franchise of the company for fifteen years, that is until 1928?

The town of Granby, Que., recently gave the contract for the installation of its lighting plant to the Canadian General Electric Co. This plant will consist of a 100 k.w. monocyclic generator, complete equipment of station instruments and a 50-light "Wood" arc dynamo. The contract also includes the complete installation of the pole line, transformers and house wiring required.

The city of New Westminster is resisting the proposal of a company, of which F. S. Barnard is a director, to tap the waters of Coquitlam Lake, with a view to electric power. The city authorities believe that New Westminster will need all the water it can get for public uses from the lake, over which it has, under Act of the legislature, rights of user as a city reservoir.

The Hudson Bay Co. has given an order to the Canadian General Electric Co. for the installation of a complete lighting plant for its stores at Calgary, N.W.T. The plant will consist of one of the Canadian General Electric Co.'s latest four-pole type generators, having a capacity of 9 kilowatts. The Goldie & McCulloch Co., Ltd., Galt, Ont., is supplying the engine and boiler required for this installation.

The works of the Ottawa Carbon and Porcelain Company are very busy at the present time. This is the only factory in Canada for the production of electrical porcelain and carbon goods, and ever since its establishment in the capital city it has made steady progress. At first the carbons produced were in some cases not up to the mark, but great improvements have been made in the process of manufacturing, and the carbons turned out this year by the company are equal to any imported goods. Besides the carbon goods for electric light purposes, the company manufacture motor brushes, and specialties in carbon for telegraph and telephone work as well. The porcelain goods include door knobs and other goods used in the hardware trade, as well as porcelain insulators, etc.

The Electric and Operating Co., Brantford, Ont., will spend $10,000 in enlarging its plant in consequence of the civic lighting contract recently entered into.

The Electric Co., St Johns, Nfld., is increasing its plant and have ordered a 150 horse-power Tandem compound engine from the Robb Engineering Co., Amherst, N.S

The Niagara Falls Park and River Railway Company ran their first trolley over the arch bridge July 1st. Mr. Rothery, superintendent of the road, was at the motor; Manager Phillips and Bridge Superintendent Dill, together with a number of other prominent citizens, were inside.

Personal.

J. R. Joughins has been appointed master mechanic of the Intercolonial Railway.

T. C. Keefer, C.E., Ottawa, was elected president of the Royal Society of Canada at its last meeting.

John Kelman, formerly of Galt, Ont, is superintendent of the Stanley Electric Mfg. Co, Pittsfield, Mass.

Thomas Graham, of the Banner File Works, Almonte, Ont., has recovered from his recent very severe illness.

J. Walter Wells, of the Kingston School of Mines, has been appointed to take charge of the assay office at Belleville, Ont.

Jas. Devlin, formerly chief engineer Kingston Penitentiary, is now one of the proprietors of the Albion Hotel, McGill st., Montreal.

C. J. Crowley, Toronto, resident engineer for the Midland Division of the Grand Trunk, severed his connection with the road on June 1.

A. P. Rankin, marine architect and engineer, formerly of Toronto, is now engaged at the works of the Cleveland Shipbuilding Co., Cleveland, Ohio.

T. W. Hugo, formerly of Kingston, Ont., is now consulting engineer for the elevator system in Duluth, Min., as well as for the electrical railway system.

A. K. Spotton, for some time draughtsman with the Waterous Engine Co., Brantford, Ont., has secured a similar position with a Toronto firm.

John O'Brien, formerly miller for Gould Bros., Uxbridge, Ont., was so badly injured by mill machinery at Creemore a short time ago that he died.

Yorke Kirton, who has been in the employ of the Lancaster Machine Works for the past five years, has gone to the works of John Bertram & Sons, Dundas, Ont.

James Stephenson, ex-general superintendent of the Grand Trunk, has, with Mrs. Stephenson, taken up his residence in a pleasant villa in the town of Cheltenham, England.

Dr. Bowen, who has been president of the Thousand Island Carriage Co. since the manufactory started, has resigned his position, and will resume the practice of medicine in Gananoque, Ont.

Henry Penton, formerly of Sarnia, Ont., now holds the position of superintendent of the engineering department of the Chicago Shipbuilding Company, one of the largest institutions of its class on the great lakes.

Wm. Mailing, the Rat Portage, Ont., agent of the Ottawa Powder Company, met with a serious accident recently which will deprive him of the use of one of his eyes. It appears that Mr. Mailing was testing a new electric battery with a percussion cap, when the premature explosion occurred, with the result that the full force of the cap expended itself in the neighborhood of his eyes.

J. H. C. Haldane, C.E., of Liverpool, England, has been travelling in Canada lately with a view of getting up a volume describing the country from the point of view of its engineering possibilities. Mr. Haldane has already published a number of books, among which are "Civil and Mechanical Engineering Popularly Considered," and "Steamships and their Machines from First to Last."

George A. Macagy, for the past three years superintendent for the hardware firm of Peck, Benny & Co., Montreal, died recently in Montreal very suddenly. Mr. Macagy had enjoyed uniform good health during the forty-seven years of his life. However, he complained of a slight indisposition, and died before medical aid could be summoned. He was born in Halifax, N.S., in 1851. Moving to Toronto while quite a young man, he entered the hardware firm of Rice Lewis & Sons, of that city, with whom he remained for seven years. He then came to Montreal, and was for seven years secretary of the Pillow-Hersey Company. Three years ago he became superintendent for Peck, Benny & Co.

W. M. Cathels, for twenty years secretary and manager of the Gas Light Co., Fredricton, N.B., has resigned his position to accept a situation in Brantford, Ont.

William Young, who has been for a number of years chief engineer on one of the Pacific mail steamers running between San Francisco and Panama, has retired from active service and returned to his home in Galt, Ont.

Michael Kelly, who died recently in Montreal, will be lamented by a large number of friends. Mr. Kelly had been recently appointed inspector of timber for the port and district of Montreal. In Quebec, Mr. Kelly was recognized as the best inspector of timber in the country, and when the timber trade largely moved to Montreal he was transferred there by Hon. John Costigan.

Ephrem Valiquette, president of the Ingeneurs-Mecaniciens Association Canadienne de Secours Mutuels, who was the winner of the gold medal at the Industrial and Mechanical Course at the Monument National, is the son of a farmer, born on June 18, 1865, at St. Martin, Laval county, Que. He is provincial boiler inspector, and also a member of the Canadian Association of Stationary Engineers. Mr. Valiquette, who has recently left the employ of W. Rutherford & Sons, was presented on that occasion with a handsome silver water jug, as a token of respect, on his leaving their employ, to become foreman for Lymburner & Mathews, mechanical engineers, of Montreal, where he is now employed.

D. W. Crockett, who died a short time ago at Hopewell, N.S., was widely known throughout the province, and particularly in Eastern Nova Scotia, where in former years he had extensive business relations. For many years he had been a government surveyor and was closely connected with the development of gold mining in the Goldenville district, having resided in Wine Harbor and other parts of Guysboro county for several years. He assisted in the construction of the telegraph line from Halifax to Guysboro and was connected with several other important enterprises in Guysboro county. He was one of the chief promoters of the Hopewell Woolen Mill Co., Ltd., of which he was secretary and manager until the property was destroyed by fire ten or twelve years ago. Chas. M. Crockett, a partner in the engineering firm of I. Matheson & Co., New Glasgow, N.S., is a son of the deceased.

Marine News.

The Yarmouth, N. S., Steamship Co., has placed the new steamer "Express" on the South Coast service.

The steamer channel running to the wharf at Depot harbor, Parry Sound, has a depth of 30 feet at the shallowest points.

The contract for the iron work of the hydraulic lift lock in Ashburnham, Ont., has been awarded to the Dominion Bridge Works, of Montreal, they being the lowest tenderers.

The contract for transporting the yearly supplies to the Government light-houses in inland waters has been let to the steamer "Seguin," owned by J. B. Miller, of Parry Sound.

Captain Pratt, Cheverie, N. S., is going to place a steamer on the route between that place, Windsor and St. John. The engines are being built at Yarmouth by the Burrell Johnson Iron Company.

The new steamer of Boutilier and Moorehouse, Centreville, Digby County, N. S., is at the works of the Burrell Johnson Iron Company, Yarmouth, N. S., having her engines and boiler placed on board.

The contract for the iron work of the hydraulic lift lock in Ashburnham has been awarded to the Dominion Bridge Works, of Montreal, they being the lowest tenderers. This is one of the largest contracts, in a single structure in iron work, that has ever been let in Canada.

The Davis Dry Dock Co., Kingston, Ont., is rebuilding at a cost of $5,000 the C. P. R. car-ferry steamer "International," which runs between Prescott, Ont., and Ogdensburg, N. Y. The same firm has a 35-foot steam yacht nearly completed, which has been built for the Muskoka lakes to the order of S. E. Gill, Steubenville, Ohio.

The steamer "Lynne," which made its maiden trip to Depot Harbor, Parry Sound, with a cargo of 214,500 bushels of corn on a draft of 19 feet, served to show what we may expect from the future development of this great port.

James Finney, of St. Thomas, has been awarded the contract for building a bridge over the Otter Creek between Elgin and Oxford.

Bras d'Or Steamboat Company, Limited, has applied for a Nova Scotia charter to carry on a general ship-owning business; capital, $20,000.

A new contract will be necessary for the reconstruction of the breakwater and repairs to piers at Goderich, Ont. The contract was originally awarded to Luke Madigan at $50,099, but he was unable to carry out the work

The Beaver Line steamer "Lake Winnipeg" is to be replaced by the New Zealand Royal Mail Shipping Co.'s steamship "Tongariro. This vessel, which has a speed of 14 knots, can accommodate 120 saloon, 70 second cabin and 250 steerage passengers.

J. D. Reid, M. D., Cardinal, Ont.; G. F. Benson, Montreal, P. Q.; D. Gow, M. D., Cardinal, Ont.; G Hall, Ogdensburg, N. Y.; J. K. Dowsley, Prescott, Ont., have applied for incorporation as The Prescott and Lake Superior Navigation Company, Limited; capital, $100,000.

The "Eurydice," the property of Sylvester Bros, Toronto, has been sold to Campbell & Rosenecke, of Buffalo, for about $6,000. The "Eurydice" has been the subject of considerable liquidation recently. Last summer she was sold to parties at Port Stanley, the price agreed upon being $10,000. The purchasers afterwards refused to receive the boat, however, and took action against the owners. The new purchasers, it is understood, will run the "Eurydice" between Buffalo and Chippewa as an excursion steamer.

J. R. Roy, resident engineer of the Dominion Government in British Columbia, who was sent up with J. L. N. Coste, the chief engineer of the Public Works Department, to examine the all-Canadian route to the Yukon, has returned to Victoria, and reports the Stickine to be a fine body of water, which steamers drawing not more than thirty or forty inches, and having powerful enough engines, may navigate for six months in the year. The trouble this season has been, he says, that several steamers with engines not powerful enough have attempted to ascend the river. The Government boat "Samson," sent to remove obstructions, could only ascend seventy-five miles.

The following have been examined by W. L. Waring, St. John, N. B., examiner of marine engineers, and passed for the following grades: O. T. Berry, St. John, third class engineers' certificate; Wm. Atkinson, Fredericton, third class engineers' certificate; G. G. Miller, Chatham, third class engineers' certificate; E. H. Haviland, Chatham, third class engineers' certificate; W. W. McLaren, Georgetown, P. E. Island, fourth class engineers' certificate; R. A. McHarg, St. John, fourth class certificate; R. S. Pendleton, Deer Island, permit; H. V. Pye, Hopewell Cape, permit; F. W. Richardson, Deer Island, permit; E. H. Strang, Lansdowne, P. E. Island, permit.

The Summer School of the Massachusetts Institute of Technology in Civil Engineering will be held at Lancaster, Mass., this year. This course in geodesy, topography and hydraulics is open to third-year men in the Civil Engineering Department. It is expected that twenty-four men, including six instructors, will attend. The work will cover, among other things, the gauging of the Nashua River below the dam, the use of the meter on the mill flumes at Clinton, the rating of the meters on Spectacle Pond, and the production of a topographical map of the vicinity of Lancaster, based on the State triangulation. Lancaster offers exceptional opportunities, not only for the work above mentioned, but also for the observation and study of the new Metropolitan Dam now being constructed, and the preparation of the basin by stripping and cleaning.

The Manchester-Canadian service is to be augmented by a new screw steamer, which has been built by Sir Raylton Dixon & Co., Middlesborough, Eng., for the Manchester Liners, Limited. Her principal dimensions are: Length over all, 461 feet; length between perpendiculars, 445 feet; breadth, 52 feet; depth moulded to upper deck, 33 feet, and to shelter deck, 40 feet 9 inches; upper bridge upon shelter deck, 128 feet long; height of upper 'tween decks, 7 feet 9 inches; height between upper and main decks, 9 feet 6 inches. The engines will indicate 4,000 h.p. and give 13 knots. The boilers, four in number, are fitted up with Howden's system of forced draught. The ship's deadweight capacity is 8,500 tons on a draught of 26 feet 3 inches, and her measurement capacity, including bunkers, about 13,000

tons. The permanent bunkers have a capacity of 1,052 tons. The "Manchester City" is expected to be ready for sea in about six weeks, and after undergoing her steam trials she will take up the regular service between Manchester and Montreal.

Mining Matters.

W. A. Saunders is to put in another steam pump at the Golden Lode mine at South Uniacke.

A number of productive oil wells have recently been sunk in Lambton county, at Inwood, Ont.

The Calumet, Que., Mining Co., has made another rich discovery on the Upper Ottawa. It is a new mine in which is said to be nearly 40 per cent of silver.

A Wilfley concentrator is being put in by the Truro Foundry Co., at the Richardson mine at Isaacs Harbor, which will be tried on two batteries as a test.

The Bureau of Mines received a letter from Michipicoten, giving the assay of sand in the placer regions of $1.50 to $6 per ton, in gold. A ton of the sand has been shipped to the Toronto Mining School for experimenting.

The Hillsboro, N. B., manganese works, which have been temporarily closed down for two weeks on account of an accident to the machinery, have resumed operations again. The repairs to the manganese press have been made by J. Weir & Sons, Moncton.

The largest flow of oil since the Petrolea oil discovery was struck last month by Trotter and McHugh of Chatham, while boring on the Herbert farm, situated about two miles from Thamesville, Ont., in the Township of Zone. It is one of a number of wells that have been lately put down in the vicinity of Thamesville. The well when tested yielded 40 barrels per hour.

On June 18 a fire and an explosion occurred in the hoisting and compressor house of the Asbestos & Asbestic Company's works near Danville, Que. Two men were instantly killed, and one other man so badly injured that he died shortly after. The loss to the company's property is heavy, and the detention of operations will be serious, as a number of large orders were being filled. The exact cause of the explosion cannot be ascertained, though it took place by the ignition of dualine.

We observe the application for incorporation of the Eastern Townships Chrome Iron Mining and Milling Company (Limited), capital stock of $50,000, headquarters Montreal; to produce and mill gold, silver, copper, chrome iron, etc.; the parties being R. Prefontaine, M.P., J. R. Fair, Montreal; C. A. Chenevert, M.P.P., Berthierville; J. U. Gregory, Quebec; C. [illegible]ing, Sherbrooke, etc.

The Bureau of Mines has issued a map of the corundum belt in Eastern Ontario, and is sending out a number of circulars, containing in concise form information concerning these deposits. The corundum bearing lands have an aggregate area of 50,000 acres. The mineral rights over nearly the whole of this tract are held by the Crown, and they have been withdrawn from sale and lease pending a report on the occurrence of the mineral and the methods of treating it, undertaken by the professors of the Kingston School of Mining. This report and a map of the region will be issued shortly.

Prof. De Kolb, of the School of Mines, Kingston, has been appointed inspector of mines for Ontario by the Local Government, in place of the Rev. A. Slaght, who died a few days ago. This office is in addition to the professor's present position, as he can perform the duties during the vacation season.

A. P. Lowe, of the Geological Survey staff, Ottawa, has left for eighteen months' field work in the interior of Labrador, continuing the line which he has been engaged upon for some seasons. It has been said that gold exists in Labrador in paying quantities, and an abundance of iron and of coal in different localities.

The first general meeting of the recently incorporated Canadian Mining Institute was held in the Windsor Hotel, Montreal, June 3rd, the president, John E. Hardman, in the chair. The principal business was the establishing of headquarters, with a mining library, in Montreal. The library, which will be located in room 4, Windsor Hotel, will be stocked with books, of which the institute already possesses about 500 volumes, periodicals, papers, maps, etc., relative to mining matters. These will be at the service of those desiring to obtain information relative to the Dominion's mining resources. Reliable information will thus be disseminated. The Dominion Government has made a grant to it of $1,000. A library committee was appointed, consisting of G. E. Drummond, convener; J. Stevenson Brown, H. B. de Courtenay, the president, and B. T. A. Bell, secretary.

—THE CANADIAN ENGINEER continues as interesting as ever to all engaged in metal, electrical, or mining work. It is monthly, only $1 a year, issued by Biggar, Samuel & Co., Fraser Building, Montreal, and should be in the hands of all mechanics.—Truro, N.S., Daily News.

—The members of the Toronto Astronomical and Physical Society Toronto, had an address delivered before them on "Our Atmospheric Ocean," by F. Napier Denison, June 28th. The lecturer gave the causes of air currents, dealing with special features of cyclones. He pointed out the various effects of aerial movement upon lakes and oceans, illustrating his statements by producing weather charts. The stereopticon views all through the lecture added much to its interest. Mr. Denison leaves Toronto almost immediately for British Columbia, where he will take charge of the weather forecasting department of the Observatory.

—Under the authorization of an act of the New York Legislature, that state will establish a College of Forestry. A conference has already been held at Albany to decide upon the location of 30,000 acres of land to be purchased for the purpose. No particular plot of ground has as yet been definitely picked upon. The conditions which the authorities decided upon as necessary in seeking land for the new college were formulated by Dr. Fernow, formerly chief of the forestry division of the department of agriculture at Washington, now director of the new State College of Forestry at Cornell University.—From the Railway Review.

—The results of the tests of the Roebling system of fireproof construction, in which a concrete arch, strengthened with steel rods, constitutes the floor support, will, we think, be a surprise to those who have not known hitherto the value of concrete as a fire-resisting material. That an arch of this construction of 4 ft. span, only 3 ins. thick in the centre, could support a floor loaded with 150 lbs. per sq. ft., while a fire was kept under it for five hours, reaching a temperature of above 2,300 deg. F., or beyond the melting point of copper and even of cast-iron, and then after this heating and sudden cooling by a stream of water could withstand a load of 600 lbs. without fracture, would, says the Engineering News, be considered highly improbable had it not been proved by these tests. The competitive test between an arch of concrete and one of hollow tile, in which the latter failed, is one of the most important contributions to our knowledge of the ultimate resistance of fireproof floors which has been made for many years. The manufacturers of tile floors will no doubt have something to say in their own behalf in regard to this test, for it was not an official one, but as the matter stands it looks as if the concrete men had shown that in fire-resisting qualities their construction is at least as good as that which has heretofore been accepted as the best standard construction.

—The total supply of manganese ore for the last year, for which returns are available, was 408,079 tons, and of this we in Britain used some 128,000 tons. The quantity required has been steadily increasing, being now five times what it was ten years ago. This is in part due to its more extended use in high-speed engines, where weight is more important than first cost, and where, therefore, it is preferred for its high tensile strength. It is also more largely adopted now for warships, which are wood and copper sheathed, and therefore require manganese bronze, or some other metal which will not readily corrode. The percentage of manganese is in such cases very small, usually 2 per cent. to 8S per cent. of copper and 10 per cent. of tin in engine castings. Stem and stern frames run up to 15 and 25 tons respectively, while propellers often weigh 17 tons. But withal, the extensive use is somewhat surprising, for what is known as naval brass is more in

favor. The proportions for engine parts are 62 per cent. of copper, 37 per cent. of zinc, and 1 per cent. of tin. While slightly cheaper, it is, as a rule, more uniformly reliable, and the tensile strength of rods is nearly as high, usually 26 tons to 28 tons per square inch. Still, we use 128,000 tons of the ore, and pay for it the very substantial price of three guineas a ton. The metal itself costs from £80 to £100 per ton, so that only great advantage would justify its use. We have to import this ore, our native production being now under 2,000 tons, although some years ago it was 12,000 tons. That, however, was at a time when copper was dear, owing to syndicate manipulations, and then even manganese ore brought nearly £4 per ton. One-half of our supply comes from Russia, a fourth from Chili, and a considerable proportion of the remainder from France. Of the world's supply of 408,079 tons, Russia provides 240,181 tons, mined in the Ural and Southern districts, but principally in the Caucasus. Ten years ago the output was only a tenth what it now is, and the increment has been steady. Germany occupies second place, with a total of 41,854 tons, taken from the Wiesbaden and Coblentz districts close by the Rhine. The production has increased fivefold in 10 years, yet the value is only double. The price per ton has indeed declined in four years or so from about £5 to about £2 per ton. Chili comes third, due to the output of Coquimbio and Atacama, the ores from which give 50 per cent. of manganese, and for it we pay nearly £4 a ton. Their total output is about 40,000 tons, of which we take three-fourths. France has 11 mines, close to the borders of Spain, and the total has increased to 32,239 tons, but is of a low grade, the value being 30s. a ton. Japan, that land of great resource and energy, takes fifth place, and the ore is of high grade. In five years their production has increased from 945 to 13,945 tons. The United States produce 9,547 tons, got principally in Virginia, Georgia, and Arkansas states. Greece has rather decreased her proportion, the total being 9,172 tons. Turkey mined 9,000 tons, while on the borders of Austria-Hungary and Bosnia, there are deposits whence the former get 2,743 and the latter 6,484 tons. Portugal finds 6,848 tons of the world's annual supply, Spain 7,684, Sweden, 3,269, and Colombia 3,950 tons. New South Wales, New Zealand, Queensland and Canada have commenced the mining of manganese ore, and it is to be hoped the colonial supply will increase.

LITERARY NOTES.

We have received from the Association of Civil Engineers of Cornell University the volume of their transactions for 1898. The transactions make a volume of about 200 pages, illustrated by a number of interesting engravings and diagrams. Among the articles of very special importance are those on towns' water supply by E. Kuichling, C.E., and European practice in the disposal of the waste of large cities, by J. H. Furtes, Mem. Am. Soc. C.E.; the present and future prospects of gas for lighting, heating and power purposes, by Henry R. Lordly, C.E.

In 1894 there was published in New York a Canadian novel which Current Literature termed the greatest American book of the year. The New York Herald, Times and other papers paid great attention to it. The title was "The Untempered Wind," and the author Joanna E. Wood. This novel is now published for the first time in Canada by the Ontario Publishing Co. of Toronto, which house also issued in the early part of the year Miss Wood's subsequent novel "Judith Moore." Paper, 50 cents.

The Hunt cable railways for handling coal and merchandise are described in a profusely illustrated catalogue, No. 9,803, recently issued by the C. W. Hunt Co., 45 Broadway, N.Y. Among the plants of which pictures are given is the locomotive coaling plant of C.P.R. at Jackfish Bay on Lake Superior. Catalogue No. 9,806 from the same firm gives details of the automatic railways and coal elevators erected by this firm.

George H. Dobson, of North Sydney, C.B., has written a pamphlet, entitled Ocean Routes and Modern Transportation, which is worthy of consideration by the Dominion Government. Mr. Dobson argues that if Canada's ocean transport facilities had been equal to those of the United States during the past sixty years, this country would have secured a large proportion of the emigrants who went to the United States.

"The Chemistry of Paints" is a pamphlet describing the process of manufacturing white lead and paints followed in the works of Harrison Bros. & Co., Philadelphia, Penn. This firm is one of the oldest in the United States, having been in business since 1793.

The International Correspondence Schools, Scranton, Pa., has sent out a handsome pamphlet describing the origin of the schools and their present condition. A good deal of space is given to a description of the various publications of the schools which are now being issued in bound volumes.

The Herald, Halifax, N.S., has issued a forty-page pamphlet on the Canadian possibilities in Atlantic freight and passenger carrying, entitled "Ocean Routes and Modern Transportation."

We have received for review the "Pioneers of the Klondyke," which is an account of two years' police service on the Yukon by M. H. E. Haine. The book is handsomely illustrated.

THE STEAM ENGINE.

BY WILLIAM GOLDING.

If an ordinary vertical steam engine be converted into a steam elevator by removing the cross-head and putting in its place a platform which shall be loaded with bricks or other units of weight, and steam be admitted below the piston, the platform with its load will ascend; if, however, the steam be shut off when the platform has ascended one-eighth the length of the cylinder, the platform will cease to ascend. As is well known, the steam which has raised the platform through one-eighth of the desired distance, is capable of much further duty; but as the load is constant, no utilization of the steam can be effected, unless the load, in some manner, be lightened. If one brick be removed, the platform with the remaining part of the load will ascend to a point where the steam and the load again become equal; where it will remain. If another brick be removed and the operation continued, the platform will continue to ascend and convey some part of the load to the top. Now it is very certain that all of the work done after the flow of steam was cut off, was accomplished by the expansion of the original steam. And this gain or economy as usually computed is sixty per cent.; yet not one-half of the theoretical gain can be discovered in any practice, and none whatever when the load is constant.

It is usual in estimating the power of the steam engine to compute the average pressure that has been exerted upon the piston as the thrust; and to assume that this pressure has been transferred to useful work. The fallacy of computing the average pressure is illustrated in the pumping engine and the direct piston-elevator, and in the locomotive, as in all of these applications the load is constant and the initial pressure always in demand. Where the load is elastic as in the screw propeller or paddle wheel, operated by engines especially adapted to such duty, a large percentage of the average pressure on the piston may be computed. But where uniform periphery speed is required, as in a mill, the percentage of average pressure to be computed in estimating the actual power developed will be governed by the percentage of irregularity tolerated in the periphery speed of the rotary parts. In fact, if the periphery of the fly-wheel travels with absolutely perfect uniformity of speed throughout each revolution, the load is practically constant and no economy can result from expansion, no matter what point of the stroke the steam may be cut off. To maintain a uniform periphery speed of the rotary parts, it is necessary that the power be uniformly applied to each division of the circle. To this end it is suggested that the greatest measure of economy will be attained by using a cylinder with permanent cut-off for each expansion, each piston to follow at equal divisions of the circle. As in this practice the full economy of steam expansion with perfect uniformity of periphery speed and against a constant load will be attained.

The subject of the fly-wheel, as a part of the steam engine, is not generally understood; and, perhaps, more failures to give satisfaction by otherwise perfect engines may be traced to the mal-proportion of fly-wheel than to all other causes. The fly-wheel is nothing in itself. It neither produces nor consumes. It can only store power by running faster, and can only part with power by running slower. To illustrate: if a single engine is to be constructed to run a mill, and is intended to cut off one-eighth of the stroke, a very large fly-wheel will be required, in order to preserve uniform periphery speed. In this case, the pressure on the piston will vary twice during each revolution, from initial to terminal, to such an extent, that in order to insure even an approximation to uniform periphery speed, a fly-wheel of unheard of proportion would be required.

The question now arises what becomes of the initial pressure when the fly-wheel is sufficiently heavy to insure perfect rotary motion; surely it cannot be averaged with the diminishing pressure, and counted as thrust, as is the practice (per indicator). For this would necessitate the fly-wheel slowing down and starting up in speed twice during each revolution, and as the resistance is assumed to be constant, and the periphery speed absolutely uniform, the answer is that "no other than the terminal pressure can be counted in estimating the power delivered." This would be unquestionably true if the piston were thrusting a plunge into a chamber of constant resistance; or against a loaded platform, and when fully understood the conditions will be accepted as being precisely the same. Duly considering the foregoing, it cannot but be admitted that where the resistance is constant, the pressure on the steam piston must be constant. And that where the fly-wheel is sufficient in weight and velocity to maintain a perfectly uniform periphery speed, operated by an engine cutting off at any fraction of the stroke, the resistance becomes practically constant, and only the terminal pressure can be estimated as passing into useful work.

—The paper by James Milne, of Toronto, on the "Steam End of an Electric Plant," was read before the Canadian Electrical Association by C. Lord Weeks, of Toronto. Press of matter has obliged us to omit this paper from the present number of THE CANADIAN ENGINEER.

IMPULSE WATER WHEELS.*

By J. T. FARMER, MA.E.

(Continued from May Issue).

In all these particulars there are some modifications which can be more or less exactly stated: (a) The velocity of the impinging jet is reduced in the ratio of a coefficient of velocity depending on the pipe line and nozzle. (b) Instead of striking the vane tangentially, the jet generally, as in the case particularly alluded to, strikes at a point nearer to the nozzle. (c) The force of impact is reduced owing to the velocity lost by the water in passing over the surface of the vane. Some previous experiments on this subject afford data which will be used in approximating to the loss due to this cause. (d) It is impossible, practically, to turn the water completely back on itself on account of the reaction which would take effect on the back of the succeeding vane.

In practice there will be a reduction of velocity, due to two causes: (1) Resistance of pipe line. (2) Loss in discharge from the nozzle. In the trials under discussion the heads given are those measured close to the point of discharge, so that no loss due to the pipe line need be considered. The only loss of velocity is that which occurs in the discharge from the nozzle. In the nozzles used in the experiments the stream issued from a parallel throat, and consequently there would be no appreciable contraction of the jet. The co-efficients of discharge were determined for these nozzles for heads up to 20 feet, above which point the variation becomes very slight. The results obtained therefore give an approximation to the true velocity of the jet. In addition to these determinations the co-efficient of discharge was calculated from the data afforded by each of the trials. These co-efficients agreed very closely with those obtained directly in the case of the ¾-in. nozzle. The mean values were .972 and .980 respectively. The discrepancy is not surprising when it is considered that in the former case the outflow was from the end of a long pipe, while in the latter it was from a large body of water at rest.

The discrepancy is more marked in the case of the nozzle ½-in. diameter, where the two values are .909 and .976. It is suggested that this difference is due to the fact that the interior of this nozzle was covered with rust at the time of its being used in the water wheel, as it had been in place for some time. The coating of oxide on the interior would diminish the actual area of outlet, so that the co-efficient would appear to be smaller than it actually was. In addition to this there can be no doubt that the rough surface of the oxide would diminish the velocity of the outflowing water; this may be partly the reason why the trials with the ½-in. nozzle show a smaller efficiency than those made with the ¾-in. nozzle. If this explanation is correct, it would point to the desirability of having the interior surfaces of the nozzle tips clean and free from rust. To accomplish this, it would probably be worth while to have detachable nozzle tips made of brass or some other metal not so liable to be acted upon as iron in the presence of moisture. It would also be advisable for the user to periodically take out and clean the nozzle tip, especially if made of cast or wrought iron. With a dirty nozzle there is a direct loss of efficiency corresponding to whatever loss of velocity is caused by the rough surface of the nozzle. More than this, there is a diminution in the area of the outlet, and therefore in the discharge, with the result that the power developed by the motor falls off. This may become a serious consideration if the motor is not much more than equal to the demands usually made upon it.

*From a Paper read before the Canadian Society of Civil Engineers.

From calculations made it was apparent that there is still a waste of from 15 to 25 per cent. of the original energy of the water which has not been accounted for. The loss due to friction of bearings would be small in a simple machine of this sort, and the greater part of the 15 to 25 per cent. loss must be due to some departure in practice of the phenomena of action from those assumed. It is suggested that the loss arises wholly or in part from the imperfect action of the vanes or buckets in turning back the water. It will be remembered that one of the functions of the wedge was described to be to cause the water to be discharged to the side of the wheel. A little consideration, however, will show that during a part of the period of action the wedge does not perform this function. When the vane begins to intercept the jet, it is the outer lip or scoop which first comes in contact with the jet. The small amount of water which strikes the blunt edge of this outer lip is scattered, and thus only gives up a proportion of its energy to the wheel. More than this, it probably causes considerable disturbance and consequent loss of energy in the rest of the stream. As the vane passes further into the path of the jet, the water strikes on the interior curved surface of the outside scoop portion of the bucket on each side of the outer end of the wedge. The curve of the bucket at this point is such that the water is mainly deflected in an inward and backward curve in the plane of the wheel, so that it emerges from the vane surface in a plane tangential to the wheel rim: it proceeds in the same direction until it strikes the back of the following vane, producing upon it a force of impact opposite to the direction of motion of the wheel. As the wheel moves into such position that the jet plays upon the central portion of the wedge, the stream is deflected to each side in a plane parallel to the axis of the wheel, and it is then and only then, that the conditions of action assumed are approximately fulfilled. It may be estimated that the action of the water is not what it is assumed to be while the vane moves over from 1-5 to 1-3 of the total arc of action. During this interval the action of the water is more or less inefficient.

It was noticed that the deficit of the actual from the calculated efficiency increases steadily as the speed is increased. It is suggested that this may be attributed to two causes. (1) The best effect of the impact occurs when the sharp edge of the wedge is perpendicular to the line of the impinging jet. This condition only occurs at one point in the arc of action. At all other points the position of the edge of the wedge departs more or less from the perpendicular position, and the deflection does not take place in the manner assumed, with the consequence that the efficiency of the impact is more or less impaired. The higher the speed of the wheel the greater is the arc of action, and consequently the greater will be the departure of the cutting edge of the wedge from perpendicularity to the line of the jet. This would mean that the loss of efficiency of the impact is less when the arc of action is smaller, or the speed small, and that the loss of efficiency increases as the arc of action increases, or as the speed is increased. (2) It was pointed out how the action of the outer lip or scoop at the beginning of the arc of action tended to impair the efficiency of the wheel. It will be seen that if the arc of action is large enough the same effect will take place at the end of the arc of action, as well as at the beginning. If, therefore, the speed is increased to such an extent as to allow this to occur, there will be a further cause of loss of efficiency at high speeds.

It is estimated that the efficiency would not suffer diminution from this latter cause until the velocity reaches a value of 800 revolutions per minute with the 175 foot head, or a value of 900 revolutions per minute with the 235-ft. head.

I.—Nozzle .5277 in. Diameter. (a) Pressure 50 lbs. per sq. inch. Equivalent head = 115 feet. Discharge = 45 gallons per second:

Speed.	Horse Power.	Efficiency.
252	.79	50.7
322	.76	48.5
398	.93	59.1
400	.86	57.0
407	.84	53.5
438	.87	56.7
450	.94	59.9
497	.96	62.8
506	.94	60.4
545	.95	60.6
551	.95	61.0
565	.84	55.7
585	.76	47.3
588	.83	52.6
625	.91	55.7
638	.91	58.3
665	.83	52.2

(b) Pressure 75 lbs. per sq. inch. Equivalent head = 175 feet. Discharge = 53 gallons per minute.

Speed.	Horse Power.	Efficiency.
345	1.38	49.8
409	1.52	54.9
477	1.68	60.7
523	1.68	61.4
582	1.80	64.7
594	1.79	65.8
632	1.75	64.4
632	1.76	63.1
672	1.78	64.1
677	1.56	55.3
725	1.63	58.3
726	1.65	59.6
737	1.61	59.7
768	1.55	55.1
779	1.57	57.0
847	1.40	51.2
879	1.31	47.7

(c) Pressure 100 lbs. per sq inch. Equivalent head = 235 feet. Discharge = 63 gallons per minute.

Speed.	Horse Power.	Efficiency.
276	1.70	37.9
306	1.85	41.2
345	1.98	44.4
387	1.90	44.5
459	2.22	49.7
470	2.36	52.8
541	2.52	56.0
605	2.67	60.0
644	2.80	63.2
698	2.76	64.0
760	2.96	65.0
834	2.65	59.5
858	2.78	61.8
914	2.76	58.6
939	2.76	57.9

(d) Pressure = 125 lbs. per sq. inch. Equivalent head = 290 feet. Discharge = 70 gallons per minute.

Speed.	Horse Power.	Efficiency.
494	3.25	52.0
536	3.32	53.6
592	3.50	57.5
664	3.79	62.1
702	3.83	63.3
765	4.00	65.2
813	3.89	62.8
867	3.93	64.8
918	3.95	64.0

(Continued in next issue.)

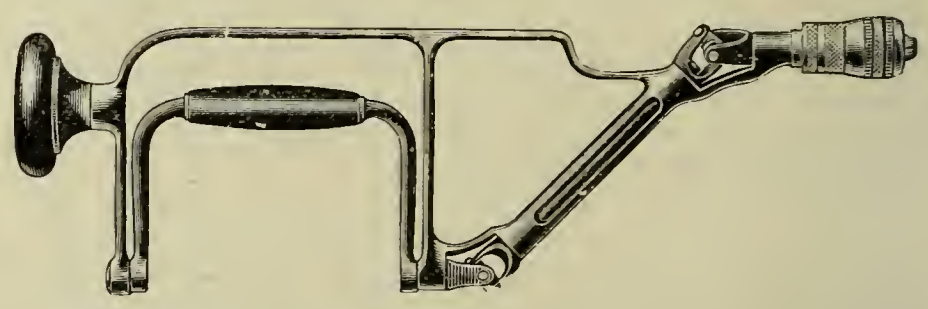
The Geo. White & Sons Co., Ltd., manufacturers of agricultural implements, London, Ont., have completed the new building, 175 x 35 ft., in which it is intended to manufacture threshing machines under rights bought recently from McPherson & Co., Fingal, Ont.

The Hamilton Facing Mill Co. have been running overtime for some months past, and have not been so busy for years as they are now.

The Garlock Packing Co., of Hamilton, have had a very busy season. Among the specialties this company is turning out is a high-grade asbestos covering which is meeting with wonderful success all over the country. The Garlock Packing Co. have won the confidence of engineers and steam users, and this no doubt is one reason why their new line of goods has come into favor so quickly.

THE UNIVERSAL BRACE.

The universal brace needs but little explanation with the practical mechanic, whether he be electrician, plumber, or carpenter; it is rapidly crowding out of the market the old-fashioned and clumsy angle brace, so long the only article of



its kind obtainable. The tool is usually supplied with a bar grip handle, which is specially adapted for overhead and horizontal work. The Aikenhead Hardware Co., 6 Adelaide St., East, Toronto, will be pleased to answer all enquiries as to price, etc., of this very necessary article.

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and all necessary electrical plant for the full equipment of a 350 2,000 c. p. electric arc light plant, together with all the necessary engines, boilers, &c., required for the steam plant to operate same, will be received at this office up to WEDNESDAY, AUGUST 3RD, 1898, where specifications and form of tender may be obtained.

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ERROR IN DRAINAGE PRACTICE.

BY W. M. WATSON.

A person living in a house that was subject to a foul odor reported the nuisance to the town's medical officer, who sent at various times each member of his staff to investigate, and they each laid the blame on the plumbing and sanitary appliances used in the house, but when an experienced sanitary plumber was engaged he looked for another cause to account for the smell, and after using pick and shovel for a few hours, he put on exhibition the reason for the foul odors, which, as usual, was the blocking of the house trap and settlement of the new drains, causing the dumping of the sewage from all the fixtures in the house into the soil under the kitchen.

Another similar, but more serious example of the many hidden dangers, I propose to relate here, showing the evils of using too many drain traps and using drains of too large a size. I was engaged to find out the cause of foul odors pervading the basement of a large factory. There were water closets, urinals and slop sinks on three of the four flats, each and all delivering into one 4-inch soil pipe extending from the drain underneath the floor to above the roof of the factory. Then every fixture was back-vented into a 3-inch cast iron pipe commencing at the basement floor and passing through each story and terminated above the roof. The plumbing and fixtures were of a high class, and well put together, but when some digging was done below the basement floor and the drains and discharge end of the 4-inch soil pipe were exposed to view, it proved that very little, if any, of the stuff coming down the soil pipe had found its way to the street sewer because the careless way the soil pipe was connected to the tile pipe drain made it almost impossible for it to do so, except at a time when there was a heavy rainstorm or when a large amount of liquid was discharged down the interior drains. Fig. 2 is a sketch showing how the drain and soil pipe were connected when found, leaving out the branch that served the basement water closets and which should be shown to join the horizontal piece of soil pipe between the two bends, immediately before it joins the tile pipe. There was a 9-inch tile-pipe drain from the street sewer to about 7 feet inside the building, laid almost at a dead level, including the trap and T pipe, then a 6-inch drain commencing with a hand-hole running trap intended to keep back the sewer gas from all the other parts of the building. This pipe passed under the factory floor for the full length of the factory, with branches to each rain water leader and slop water gully in the yard, having a grade of only about 1 in 100, and clayed joints. The total length of the 6-inch pipe laid under the floor would be over 100 feet, which would be equal to a storage tank holding about 140 gallons. The 9-inch trap would hold about 40 pounds of water, and the water in the T pipe would have to be 1 inch deep before it could in any way move such a bulk of water as rested in the 9-inch trap, and then the liquid only would be able to get round the dip, while the solids would stay in the dip of the trap and choke it. The largest flush a soil pipe would discharge at one time would be 3 gallons, under 30 pounds in weight, and in this case it discharged vertically through a square T, striking the opposite side or bottom of the 9-inch pipe. The sewage then had liberty on account of the drain being level to choose its own road, and of course preferred the easiest, which was to pass backward through the 6-inch trap that only holds about 20 pounds of fluid or half the amount of a 9-inch trap, which would be soon choked and blocked up with solids. The drains being nearly level throughout their whole length they would hold about 50 gallons of sewage in store before a reaction would take place, even if the 9-inch trap was free, and the fluid begin to dribble outwards towards the street sewer. The 50 gallons would therefore generally be lodging in the pipes or wasting away through the defective joints in the sewer pipes and contaminating the sub-soil under the planked floor. The excrements and paper of sewage will, if well distributed among the fluid, dissolve into a liquid in a few days, so that when there is a space, as there was at this factory equal to 50 gallons, acting as a storage and liquefying chamber, they may continue to dispose of the excrements for a number of years through leaking joints and never have a real choke to enable the owners to find out what hidden damage is done to the building and inhabitants. A 4-inch soil pipe can never flush the sewage it delivers through 9-inch pipe traps, because it is about five times larger than the 4-inch soil pipe. The fluid coming down the soil pipe will pass through the largest trap only by soaking through slowly, devoid of any carrying force, which makes it nearly impossible to carry down any substance heavier than water. Therefore to put in a 9-inch

tile trap to serve a 4-inch soil pipe is about the same as plugging up the end of the drain to prevent anything passing through to the street sewer. The 9-inch drain was too large for the work, but it might answer if the soil pipe was made to enter as shown in Fig. 1, and the trap dispensed with, which was unnecessary in this case, and not demanded by any town by-law.

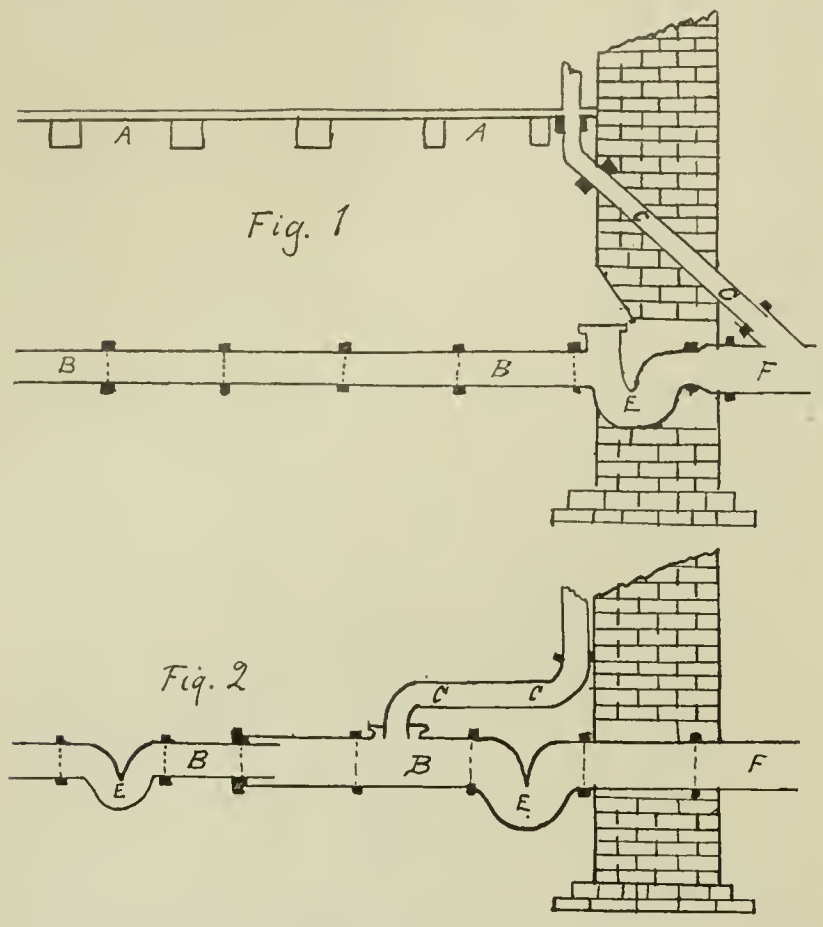


Fig. 1—Plumbing arranged in a satisfactory manner. Fig. 2—Plumbing as actually installed. A A—Factory floor. B B—Tile drain below floor. C C—Soil pipe. E E—Traps. F F—Street drain.

When drains are almost level and in a position as found in this factory, it would be much better and safer to have a reflex flag valve in behind the soil pipe and near the trap, to prevent excrement backing under the factory or the sewage coming back when the flood occurs. No doubt the idea of laying the 9-inch portion of the drain was to leave plenty of room for the contents of the soil pipe when the 6-inch drain was delivering the storm water at full bore, but it was not necessary on that account, because the soil pipe would only deliver occasionally, and then only about three gallons at one time, and that small amount would have very little effect on a stream passing through a 6-inch pipe, and a good rush and flush four times in a year, which is as often as an extra large rain storm comes. When the plumber who did the work, when newly erected, saw the square T junction and 9-inch pipe to connect his 4-inch soil pipe to, he ought to have declined to join the drain in that way. And if his instructions were imperative that the soil pipe should have an intercepting trap and breather, he might have attached a 6-inch, or, better still, a 4-inch hand-hole trap and breather pipe, and after connecting them the pipe might have been coupled to the line of 9-inch drain pipes by a side junction. By making this mistake a large amount of expensive first-class work was rendered dangerous by the error of connecting the soil pipe into the square T junction, and behind a useless 9-inch interception trap, as shown in Fig. 2.

—A correspondent, who is a member of the Canadian Electrical Association, writes to express his admiration of the electrical and mechanical experimental plants at McGill University, Montreal, and to convey the thanks of himself and friends for the courtesy shown by the faculty on the occasion of their visit during the recent convention. Our correspondent was particularly struck with the clearness and simplicity of the answers given by Dr. L. A. Herdt to every question asked by the members when visiting the electrical laboratory. This faculty in Prof. Herdt has struck many others since his connection with McGill. To possess a profound knowledge of a subject and to be able to impart this knowledge in a way that a learner can clearly understand, is a combination of gifts possessed by few. The record which this young professor has already made, both as a practical electrician and an investigator, indicates a most promising future for him, and it should be a peculiar satisfaction to McGill to have a native-born Canadian of such talent at the head of its electrical department.

RESULTS OF EXPERIMENTS ON THE STRENGTH OF WHITE PINE, RED PINE, HEMLOCK AND SPRUCE.*

BY PROF. H. T. BOVEY, LL.D., D.C.L.

In a paper read before the Canadian Society of Civil Engineers, in 1895, the results were given of a number of experiments on the transverse strength of timber beams; but in the calculations it was assumed that the distortion, or diminution of depth at the bearing surface, was sufficiently small to be disregarded. It often happens, however, and especially when the timber contains a large amount of moisture, that the change in depth due to compression is excessive, producing a corresponding increase in the skin-stress. The method of conducting these experiments was fully described in the paper referred to, and therefore the following points only are noted:

All the transverse tests were made with the Wicksteed machine. The middle of the beam was supported on a hardwood bearing of 44 inches diameter. The two ends were forced down by rams under hydraulic pressure, which can be gradually increased at any required rate, or can be maintained constant for any given time. The end-pressures were kept normal to the surface of the beam by means of spherical joints, which allow the end bearings to revolve. In previous experiments, the wire used in observing the deflections was found to be somewhat coarse, and a special wire was therefore drawn of .002-inch diameter.

The flexure theory is admittedly unsatisfactory, and frequently gives results which are contrary to experience. Possibly, when a certain limit has been passed there is a tendency towards equalization of stress, and the so-called neutral surface may be moved towards that portion of the beam which is best able to bear the stress. It may indeed be more correct to assume that the distances of this surface from the tension and compression faces are in the ratio of the ultimate tensile and compressive strengths of the beam. This assumption at all events seems to give results which are more in accordance with practice. For example, in the case of a cast-iron Tee bar, tested in the University Laboratory, the tensile skin-stress should be 22,030 lbs. per sq. inch, and the compressive skin-stress 102,050 lbs. per sq. inch, wheras the ordinary theory gave 33,000 lbs. per sq. inch as the tensile and 20,800 lbs. per sq. inch as the compressive skin-stress.

The following tables give the breaking weights, skin-stresses, (transverse), coefficients of elasticity and specific weights of a number of air-dried, saturated, frozen and kiln-dried beams.

*Extracted from a paper read before the British Association for the Advancement of Science, Toronto, 1897

TABLE I.

White Pine From Ordinary Stock.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity in lbs. per sq. in.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at		Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.	*E.*		Centre.	Left end.	R't end.	
15	186	6.225	15.2	23,850	5,021	4,777	4,889	1,296,950	36.43	.....	.....	.....	Crippled.
16	186	6.32	15.25	22,690	4,774	4,480	4,627	1,359,050	38.64	.....	.....	.....	Longitudinal shear.
28	138	9.1	15.21	39,000	4,403	4,018	4,210	1,078,230	27.121	17.29	12.89	13.21	Longitudinal shear.
32	186	6.025	12.25	16,000	5,531	5,153	5,342	1,368,500	27.983	28.262	27.014	27.274	Crippled.
46	186	5.725	5.9	5,200	8,967	7,312	8,389	1,625,220	23.794	.....	.....	.....	Crippled.

TABLE II.

White Pine Dried at 212° F.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity in lbs. per sq. in.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at		Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.	*E.*		Centre.	Left end.	R't end.	
17	186	6.15	15.2	21,350	4,531	4,322	4,426	1,252,700	32.279	.....	.....	.....	Crippled.
18	180	5.75	15.0	21,730	4,589	4,466	4,527	1,351,350	.....	.....	.....	.....	Crippled and longitudinal shear.
31	186	5.975	12.275	23,400	7,840	7,469	7,654	1,814,190	35.95	17.38	16.9	12.94	Longitudinal shear.
45	186	6.025	6.025	7,600	10,034	9,871	9,952	2,768,630	37.144	.....	.....	.....	Crippled.
49	188	5.75	14.925	22,700	5,240	5,100	5,170	1,669,010	30,592	8.8	8.7	8.1	Longitudinal shear.

TABLE III.

Red Pine From Ordinary Stock.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.			Centre.	Left end.	R't end.	
37	150	5.75	11.875	21,000	6,160	5,953	6,056	2,049,430	30,672	.....	.....	.....	Longitudinal shear.
41	150	5.885	5.925	8,800	9,572	9,472	9,522	2,261,820	30,858	.....	.....	.....	Tensile.
44	150	5.875	11.785	20,000	5,732	5,617	5,674	2,219,550	34,038	.....	.....	.....	Longitudinal shear.

TABLE IV.

Red Pine Dried at 212° F.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.			Centre.	Left end.	R't end.	
36	150	5.95	11.925	.....	.....	.....	.....	.....	.....	.....	.....	.....	Tensile.
38	75	2.965	5.925	5,000	2,201	2,164	2,182	1,245,780	22.007	.....	.....	.....	Crippled.
42	150	5.7	5.9	8,000	5,911	5,569	5,740	1,272,440	22.105	.....	.....	.....	Tensile.
43	150	6.05	11.725	23,000	9,538	9,247	9,392	1,282,770	20.674	.....	.....	.....	Tensile.
					9,992	7,091	8,542	1,171,240	22,648	.....	.....	.....	Tensile.

Beams 15 and 16 were sawn out of trees felled at Keewatin in 1894, and were received into the Laboratory on the 13th of December, their weights being 415.75 lbs. and 457.78 lbs. respectively. They were both tested on the 2nd of February, 1895, when it was found that beam 15 had lost 36.69 lbs. or 8.8 per cent. of its weight, and that beam 16 had lost 46.59 lbs. or 10.2 per cent. of its weight. When the beams were sawn through after the test they were still found to be completely saturated with water excepting for a depth of 1 inch from the surface. The beams were from the central portion of the trees, the heart running from end to end. Beams 28 to 43 were sawn from trees felled in water, 1893—4, in Quinze Lake Co., P.Q. They remained in water one year, and were received into the Laboratory on October the 4th, 1895. They were all first quality timber, and, generally speaking, straight in grain and free from knots and shakes. In order to determine the excess of moisture in the timber, three slabs, one near the middle and one at each end, were sawn out of the beams immediately after they had been tested and were at once placed in a chamber kept at a temperature of 212° F. by steam-pipes. The moisture was also removed from the whole beams by drying them in the same chamber. Beam 36 failed suddenly under a very small load, the fracture commencing at a knot in the tension surface. On exam-

ination it was also found that the grain on the face was oblique to the neutral surface, while there were shakes running from end to end in the neighborhood of the heart which, on the average, was below the middle of the depth of the beam. The results of this test should be discarded, as the beam was not of fair average quality. Beam 38 was cut out of beam 36 in such manner that the grain was straight.

Beam 43 failed under a breaking load of 23,000 lbs., but a somewhat long continued and slowly increasing deflection under a load of 22,000 lbs. seemed to indicate that at this point the beam failed in compression, although there were no apparent signs of crippling.

TABLE V.

HEMLOCK FROM ORDINARY STOCK.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.		Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft.	Per ct. of weight lost when dried at 212 deg. F.		Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.				
25	222	8.815	10.1	13,000	5,132	4,995	5,063	1,581,710	53.025	50.43	39.93	47.85	Crippled.
26	186	8.975	10.015	20,000	6,615	6,371	6,493	1,498,640	36.533	.....	.....	.....	Crippled.
29	186	9.85	11.95	20,040	4,133	4,058	4,096	883,291	36.235	34.6	.....	.....	Tensile.

TABLE VI.

HEMLOCK DRIED AT 212° F.

40	87	4.35	4.925	3,500	7,946	5,054	6,500	1,379,860	31.346	.....	.....	.....	Longitudinal shear.

TABLE VII.

HEMLOCK SATURATED AND FROZEN.

22	138	9.0	11.875	30,800	5,393	5,166	5,280	1,174,700	38.69	.....	.....	.....	Tensile.
23	138	9.025	11.9	21,000	3,482	3,450	3,466	1,242,150	45.23	.....	.....	.....	Tensile.
35	190	9.175	10.05	22,000	7,188	6,960	7,074	1,633,050	50.707	51.07	49.75	57.42	Crippled.

Remarks.—Beams 17 and 18, containing the heart, were cut from trees felled at Keewatin in 1894, and were ordinary 1st-quality timber. There were shakes in beam 17, reaching the heart at points. The grain on the lower half of the beam was straight, but ran cross-wise on the tension surface. From the time the beam was received into the Laboratory to the date of the test, a period of 57 days, the beam lost 13 per cent. of its weight. After the test a 3-inch slab was cut out, and the weight of this slab on Feb. 15th, 1897, by which time the natural drying can be considered to have been completed, was found to be 28.037 lbs. per cubic foot. Beam 18 was tested after remaining in the Laboratory 42 days, in which time it was found to have lost 8.79 per cent. of its weight. It failed by crippling and longitudinal shear, simultaneously. The grain for about 10 inches

TABLE VIII.

SPRUCE FROM ORDINARY STOCK.

No. of Beam.	Dimensions in inches			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at		Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.			Centre.	Left end.	R't end.	
24	222	9.175	10.1125	15,800	6,208	5,846	6,027	1,629,050	32.307	26.7	24.7	27.3	Crippled.
27	186	8.725	10.025	14,600	4,899	4,758	4,829	1,458,360	29.354	.....	.....	.....	Crippled.
30	186	8.725	11.875	15,900	3,758	3,682	3,720	2,020,300	30.603	11.1	.....	.....	Longitudinal shear.

TABLE IX.

SPRUCE DRIED AT 212° F.

39	78	3.775	4.35	5,800	9,774	9,603	9,689	2,373,080	31.606	.....	.....	.....	Longitudinal shear.

TABLE X.

SPRUCE SATURATED AND FROZEN.

33	186	9.2	10	14,000	7,212	6,887	7,050	2,373,080	39.78	30.618	33.55	.....	Crippled.

on each side of the centre was clear, straight and free from knots. The logs from which beams 31 to 49 were sawn were felled in the Bonnechere district in the winter of 1894—95, and remained in the water for six months. They all contained the heart, and were ordinary 1st-quality timber. Beam 32 failed by longitudinal shear along a shake in the neighborhood of the neutral surface, but there were indications that this had been immediately preceded by a slight crippling.

Remarks.—Beams 22, 23 and 35, containing the heart, had lain in the water for a considerable time, and were completely water-soaked. When tested, beams 22 and 35 were found to be hard frozen. Beam 23 was also frozen, but not throughout, as was shown when the beam was cut in two at the centre. Beam 22 was straight-grained, free from knots, and failed with a sudden sharp fracture. Incipient decay had commenced near the heart of beam 23, which, however, was regarded as a fair specimen of ordinary commercial quality. It was full of large knots and the grain was curved from end to end. Beam 35 was straight-grained, clear, comparatively free from knots and of exceptionally good quality; beam 40 was cut out of beam 35 after the latter had been tested. Beams 25, 26 and 29 all contained the heart. Beam 25 was a good specimen, and was completely water-soaked. Beam 26 was saturated throughout, excepting for a depth of 1½ inches from surface, and, although an apparently poor specimen, was considered to be of ordinary commercial quality. It was full of knots and its grain was curved.

Remarks.—Beam 24 was wet, but was in good condition and comparatively free from knots. Beam 27 was of ordinary commercial quality, with fairly straight grain and a large number of small knots. Beam 30 was of ordinary commercial quality, but with large shakes running from end to end and dividing the beam practically into four sections. Beam 33 was water-soaked and hard frozen when tested. It was of exceptionally good quality, free from shakes and had clear, straight grain. Beam 39 was cut out of beam 33 after the latter had been tested.

In the transverse experiments the greatest possible care was taken to increase the load at the same uniform rate, the average time occupied in adding each increment and in taking the corresponding reading being slightly greater than 1 minute. In many cases the beam was loaded, then relieved of load, and reloaded again, the readings in all cases being carefully noted. This operation was sometimes repeated more than once. Whenever a beam or a specimen under tension or compression was subjected to repeated loadings, the first series of readings were almost invariably discarded as the increments of deflection, and changes of length were found to be more uniform after the preliminary loading. The initial loading seems to eliminate certain inequalities of resistance.

In beam 15 there was an increment of .401 inches in the deflection, corresponding to an increment of 7,000 lbs. in the load. On reducing the load to 500 lbs., there was an apparent set of .006 inches, which would have undoubtedly disappeared in a short time. Upon reloading the beam, the increment of deflection for the same increment of load was .4 inch. In beam 17 the increments of deflection under the first and second loadings were exactly the same, viz., .415 inch for an increment of 7,000 lbs. in the load. When the load, after the first series of readings, was reduced to 500 lbs., there was an apparent set of .005 inch, which would have certainly disappeared had the beam been allowed to rest for a few minutes. In beam 24 (Spruce), for an increment of 6,000 lbs. in the load, the increment of deflection was 1.04 inch in the first loading and 1.034 inch in the second. Upon being entirely relieved of load, there was an apparent, but evidently only apparent, set of .01 inch. In beam 25 (Hemlock), for an increment of 6,000 lbs. in the load, the increment of deflection was 1.165 inch in the first loading and 1.155 inch in the second, the apparent set when entirely relieved of load being .01 inch. In beam 27 (Spruce), after being loaded and then entirely relieved of load, there was an apparent set of .005, which in two hours had fallen to .002 inch. In beam 26 (Hemlock), after being loaded and then entirely relieved of load, there was an apparent set of .004 inch which had entirely disappeared after an interval of about two hours.

In the case of beam 28 (White Pine), there were three sets of loadings, the increments of deflection corresponding to an increment of 12,000 lbs. in the load being: .238 inch and .234 inch for the first set, .237 inch and .232 inch for the second set, .237 inch and .232 inch and .232 inch for the third set.

When the beam was entirely relieved of load after the first set, there was an apparent set of .002 inch, which had entirely disappeared in 25 minutes. The second set of loadings commenced after an interval of 18 hours. The mean increment of deflection=.2344 inch; the mean compression=.0827 inch, and, using the ordinary formula, the corresponding value of E=1,066,980 lbs.

The increments of deflection for repeated loadings corresponding to an increment of 6,000 lbs. in the load were: .675 inch, .660 inch, .650 inch, for beam 29 (Hemlock), .335 inch, .330 inch, .337 inch for beam 30 (Spruce), .492 inch, .485 inch, .487 inch for beam 31 (Red Pine), .675 inch, .655 inch, .653 inch for beam 32 (White Pine), .313 inch, .308 inch, .305 inch for beam 49 (Red Pine).

The increments of deflection for repeated loadings, corresponding to an increment of 7,000 lbs. in the load, were: .625 inch, .620 inch, .620 inch, .625 inch for beam 33 (Spruce). The increments of deflection for repeated loadings, corresponding to an increment of 5,000 lbs. in the load, were: .590 inch, .556 inch, .555 inch, for beam 35 (Hemlock).

For beams dried at 212° F., the increments of deflection for repeated loadings were: .420 inch, .400 inch, .405 inch, .405 inch, .405 inch for beam, 36 (White Pine), and an increment of 6,000 lbs. .178 inch, .173 inch, .173 inch, for beam 37 (Red Pine), and an increment of 4,000 lbs. .039 inch, .042 inch, .040 inch, .040 inch, for beam 38 (White Pine), and an increment of 300 lbs. .048 inch, .048 inch, .048 inch, .049 inch for beam 39 (Spruce), and an increment of 300 lbs. .071 inch, .070 inch, .070 inch, .070 inch for beam 40 (Hemlock), and an increment of 300 lbs. .363 inch, .358 inch, .358 inch, .363 inch for beam 41 (Red Pine), and an increment of 1,200 lbs. .669 inch, .672 inch, .675 inch for beam 42 (White Pine), and an increment of 1,200 lbs. .411 inch, .416 inch, .408 inch, .402 inch for beam 43 (White Pine), and an increment of 6,000 lbs. .243 inch, .240 inch, .238 inch, .241 inch for beam 44 (Red Pine), and an increment of 6,000 lbs.

From these results and from the further observa-

tions up to the point of fracture, the following inferences may be at once drawn: (a) The increment of deflection diminishes and therefore the coefficient of elasticity increases with the elimination of the moisture from the beam. (b) The increments of deflection are much more uniform in amount in the case of kiln-dried beams.

It is, of course, impossible to maintain a beam in a kiln-dried state. As soon as it is exposed to the atmosphere, it at once commences to absorb moisture, and the absorption continues until there is an equilibrium between the hygrometric conditions of the beam and atmosphere. The beam is then in its normal state, and the experiments indicate that the increments of deflection, corresponding to this state, are approximately uniform. The rate of absorption depends essentially upon the nature of the timber, and proceeds more slowly as the density increases. The weight of a central 2-inch slab of beam 30 (Spruce), increased 3.6 per cent. in 24 days, and 8.5 per cent. in 47 days. The influence of moisture on the deflection of a beam was well illustrated in the case of 15 inch x 6 inch Douglas fir beam on 186 inch centres. On June 15th, 1895, it was placed in position and was loaded with a weight of 1,000 lbs. at the centre, producing a deflection of .071 inch. The daily observations, extending over several months, showed a continually increasing deflection, until, by the evaporation of the moisture, the beam had attained its normal state. The average deflection now remained constant, varying, for example, between .09 inch on August 24th, and .082 inch on September 2nd, the greater deflection of course corresponding to an increase of moisture in the atmosphere. On the 4th of September, the load was increased to 2,000 lbs., which produced a deflection of .127 inch. This load remained on the beam until January 8th, 1896, the deflection during the same period varying between .129 inch and .114 inch.

Of 20 non-kiln dried beams, 11 failed by crippling on the compression side, 6 failed by longitudinal shear, and 3 hemlock beams only failed by the fracture on the tension side. The experiments on the direct tensile and compressive strength of the timbers show that this is precisely what might be expected to take place. In every case the direct tensile strength is very much greater than the direct compressive strength, and failure by crippling is likely to take place under a load much less than the material could bear in tension. Under all circumstances, therefore, in practice, it is advisable to place a beam so that the portion of the timber which is strongest and in the best condition should be in compression. Again, the experiments conclusively show that kiln-drying enormously increases the direct compressive strength, but greatly diminishes the shearing strength, while the direct tensile strength does not appear to be much affected, although in the majority of cases it was diminished, and sometimes considerably. The large increase of strength in compression due to kiln-drying might have been naturally expected, as in the process of drying the walls of the cells are stiffened and hardened, and thus become better able to resist a compressive force. The walls, however, are at the same time much more brittle, and it is possible that a sudden blow might cause the failure of a kiln-dried column, which would have remained uninjured had the moisture not been eliminated. It may also be of interest to note that in the re-tests of specimens after the injured portion had been removed, the compressive strength was, almost without exception, increased. Hence, by kiln-drying a beam its compressive strength is made to approximate more closely to its tensile strength, and its transverse strength is consequently sometimes considerably increased. It must be remembered, however, that this kiln-drying invariably largely diminishes the shearing strength, and therefore proportionately increases the tendency to shear longitudinally. Thus, of the nine kiln-dried beams in the preceding tables, only one failed by crippling while four failed by fracture on the tensile side and four failed by longitudinal shear. Indeed, generally speaking, kiln-dried beams will fail either by a tensile fracture or by a longitudinal shear, and this result has been further verified by experiments subsequent to those referred to in the present paper.

In practice, of course, beams cannot be maintained in a kiln-dried state, but they rapidly pass into the normal state. The question of how far it is desirable to eliminate the moisture depends essentially on the balance to be maintained between the tensile, shearing and compressive strengths, and a beam should always be placed so as to exert its relative strength to the best advantage. Kiln-drying, unless some special method of prevention is adopted, develops shakes in the timber and causes existing shakes to become more pronounced. Some of these shakes often extend to a great depth and run the whole length of the beam, so that it not infrequently happens that only a slight layer is left to hold the beam together. Such a beam, although otherwise sound and clear, offers very little resistance to longitudinal shear, and might more justly be regarded as being made up of two or more superposed beams.

When this paper was read by Prof. Bovey before the Canadian Society of Civil Engineers, the following discussion ensued:

Prof. Bovey replying to a question stated that the direct tensile strength of timber is much greater in every case than the direct compressive strength, for instance, if 10 represented the tensile strength, 5 would represent the compressive, and for that reason, as his experiments showed, it was always best and safer to put the best side of the timber in compression.

Mr. Peterson replied that while Prof. Bovey's tests indicated that the failure usually took place on the compression side he found that in actual practice the timber invariably failed on the tension side, therefore, he maintained, the direct compressive strength of timber is greater than the direct tensile strength.

Prof. Smith said incipient failure having occurred on the compressive side the neutral axis shifts its position and throws an additional strain in tension.

Prof. Bovey.—A beam which had apparently failed on the tension side, had in reality been first weakened by crippling in compression (which is not always visible), and this threw an additional strain on the tension side, which thereupon ruptured first. No two pieces of timber give the same results, they vary greatly, e. g., if you can cut a piece of timber into three parts longitudinally you will find they vary largely, as far as strength is concerned.

Mr. Irwin pointed out that after a timber had failed the part injured in compression would return so as to escape observation easily, whereas an actual rupture gradually took place on the tension side.

Mr. Peterson said, speaking of bridge trusses, that he had never known the top chord to fail, and that it was not nearly so liable to do so as the bottom chord, therefore it does not coincide with the experiment made.

Prof. Bovey replied that the cases of a bridge truss and a beam of timber were not parallel, and that the top chord of a bridge truss was subject to direct compressive strains very different to those in a beam under the load.

Mr. Duggan remarked that a bridge truss never failed in the solid, but only in the joints, these being the weakest points.

PROGRESS OF CALCIUM CARBIDE.

The manufacture of calcium carbide has been making steady and rapid progress during the past year, and it is satisfactory to note that as the discoverer of the first commercially successful method of production is a Canadian, Canada now takes the lead in its manufacture. In our issues of January, 1896, February, 1897, and January, 1898, as well as in other numbers, historical and technical descriptions were given of the manufacture of calcium carbide and its product, acetylene gas, along with a biographical sketch of the discoverer, Thomas L. Willson, now head of the Willson Carbide Works Company, of St. Catharines and Merritton. A visit of a representative of this journal to the works at Merritton shows that the manufacture of carbide has greatly developed since our last report. There are now three power stations, producing a total of 1,500 h.p. and operating six furnaces, which are running night and day. The export of calcium carbide from these works had last year risen to $22,000, but this year the output will be $50,000, and it only requires sufficiently large factories to multiply this production by ten. That Mr. Willson has always had a most complete faith in the future of acetylene may be inferred not only from what has appeared in these columns from time to time, but from the fact that he ventured an outlay of $250,000 when as yet the character of the public reception of acetylene was a problem. It is no longer a problem, however, for Canadian calcium carbide is now being shipped to the remotest ends of the earth. On the day our representative called a shipment was being made to Hong Kong and another to Shanghai, while just before that a large shipment had gone to South Africa. Two carloads per month now go regularly to New Zealand, while three shipments had been made to the Klondyke, and an offer had just been received from Dawson City for 100 tons to be forwarded immediately. A single firm in Manitoba takes 42 tons per month. The consumption is increasing in each province of Canada and little by little the insurance companies have yielded up the prejudices that existed before the character of acetylene gas became so well known. Recently the Underwriters' Association of Toronto abolished the extra premium of 10 per cent. which had been charged against users of acetylene gas. One remarkable recent development in this gas is its extensive use for bicycle lamps. For use in this line of lighting alone three car loads were recently ordered by one Canadian firm, and this consignment was expected to be exhausted in two months. In Toronto, where cyclists are not compelled to carry lamps at night, there is comparatively small consumption for this purpose, but in Montreal, where the city by-laws require each wheelman to carry a lamp at night, the popularity of the acetylene bicycle lamps is remarkable. The contrast between an acetylene and oil lamp is very striking. The oil lamp, which is only used by about one out of five in Montreal, makes a very dismal gleam by the side of the acetylene gas lamp. Four ounces of carbide will last seven hours in a bicycle lamp, the carbide being retailed at 25 cents for a 2½ pound can. The cost varies from ½ a cent. to 1 cent per hour, and apart from the brilliancy of the light a charge will last much longer than a charge in an oil lamp. Some very convenient students' lamps are now being put on the market for acetylene, while its use for domestic lighting generally is steadily increasing. We have before referred to the fact that the explosive power of acetylene gas in gas engines is much greater than that of oil or gas. While of ordinary gas 18 to 20 cubic feet are required to produce a horse-power, the same power can be obtained from 5 cubic feet of acetylene gas. Acetylene therefore yields about four times the power of other gas. To put the question in another shape, a great saving of space and weight can be gained by the use of acetylene gas engines, and for light power these engines can be built so small as to be practically noiseless. As compared with coal a given power can be obtained from about one-seventh of the weight of carbide. That is to say, where about seven pounds of coal are required per horse-power, one pound only will be needed of carbide, a pound of the carbide producing five cubic feet of gas. The explosions from acetylene are quicker than from coal gas or oil, and consequently greater speed can be obtained. Our readers may be interested to know that the Union Carbide Company of Chicago have bought the plants at Niagara Falls, at Sault Ste. Marie, Michigan, and in Virginia, the united company being capitalized at $6,000,000 or $8,000,000. Large developments are in consideration in Canada, also, and at Grand Mere, in the Province of Quebec, a water-power capable of yielding 100,000 horse-power has been acquired to extend this interesting industry. The promoters have unlimited capital at their back, among those interested being William McKenzie, the well-known capitalist of Toronto.

ASSOCIATED PLUMBERS' CONVENTION.

The second meeting of the National Association of Master Plumbers of Canada was held at Quebec on June 29th and two following days, Joseph Wright, of Bennett & Wright, Ltd., being in the chair. By carefully reading the reports of the officers and committees and the minutes of the business done during the three days' deliberations of the association, the public will come to the conclusion that its interests appear to be taken into scant account. The published reports show that the chief aim of the meeting of the association and the previous executive meetings was to create a monopoly in the trade for the benefit of the members and to make rigid rules which would bring all the trade into line with the combination. There is a total absence in the asociation's discussions and the officers' reports of subjects touching on improved sanitary methods and scientific plumbing, heating or gas fitting.

If the proceedings of the Associated Master Plumbers of Canada, so far as made known, be a sample of the treatment the public may expect at their hands, then we must accept the association as a combination in restraint of trade, whose aim is to increase its members' profits at the expense of the public liberty and purse. It is quite legitimate and even commendable for trades and business men to associate together, and combine their influence, knowledge, and advice, to protect themselves and to exchange ideas with each other with a view to raising the standard of the trade and improving the class of work and remuneration, but when associations make it their business to interfere with the liberties of others and damage private enterprise by using their combined strength to compel others to adopt their views, rulings and methods of working, or retire from business, it is quite time that the public should make its voice heard in the discussion. The report leads us to believe that this association intends if possible to secure Acts of Parliament and by-laws in every town that will enforce the Master Plumbers' Association's dictatorship on the population of this country, which is already sufficiently ruled and regulated. The city of Toronto appears to be the birthplace of the association, and during the past few years we have been able to note

how such a monopoly works, and therefore gather some idea of what may result when the association fully develops and its rules are enforced by the Legislature. When the Toronto association was only a few months old, and standing alone, it persuaded the Toronto city council to embody some of its ideas in by-laws, and no person was permitted to commence or carry on the business of master plumber or do a job of plumbing work on his own account, except he passed the Toronto Board of Plumbers' examinations and had an established place of business. The board consisted of Joseph Wright, W. J. Burroughs, master plumbers, and E. J. Lennox, city architect. This body has also the privilege of saying who was qualified to fill the appointment of inspector of plumbers' work and enforce the city by-laws. It will be obvious that such extensive powers in the hands of business men require the most judicious and conscientious exercise, and that even then friction would be occasioned. The journeymen were to be examined also, but a strike made it impossible to carry this out and the idea was dropped.

Some difficulty has been experienced in enforcing the Toronto by-law, and in some cases the city has failed to secure convictions under it, though there was no doubt that the defendants were not licensed and were carrying on business as plumbers. We find by the reports of the Quebec meeting that the difficulty in compelling all plumbers to enter the combination is about to be overcome in another way. The manufacturers of plumbers', gas and steam fitters' supplies must act in harmony with the Master Plumbers' Association of Canada and agree to sell goods at manufacturers' prices only to members of the association. This will practically prevent anyone doing business who can not or will not join the combine, because he will not be able to secure the necessary material at trade prices. We may also expect that in time the license fee will be advanced to an amount that will prevent anyone but a capitalist paying it, and thus prevent those who have served an apprenticeship, but are not fortunate enough to possess the money to pay the license fee, from taking the advantage of their years of education and work. We have also observed the great difference in the two tenders for the plumbing and heating of the new city hall, Toronto, the one being made at the time the other contracts were let, and the other accepted a few years after, when the Toronto Master Plumbers' Association had had time to get its members into line.

WHO IS "EXPERT"?

I notice in your last issue that John McDougall, the agent for the International Sewage Purification Co., demands my name. It is Henry Lee McKinstry, born at Armagh, Ireland, my father being a land owner there and medical health officer for the district. I, myself, was formerly a traveler in England representing a wine manufacturing syndicate, and I came to Canada a few years ago with the intention of learning the habits and customs of the people, and the value of the land, the products, minerals, etc. I hear and secure considerable information on many important subjects and know probably more about sewage purification and the international system than Mr. McDougall does himself, and I am prepared to prove every word spoken in the letter complained of, and to discuss sewage purification with Mr. McDougall in any public hall, after November 15th, when I propose to make a long stay in Toronto, and allow the audience to say by show of hands whether Mr. McDougall or myself is the most competent person to judge such an important subject. I have no interest in any sewage scheme in this or any other country, or desire to interfere with any private or public business, nor am I acquainted with Mr. McDougall or any other agent, but when I became acquainted with all the facts of Mr. McDougall's offer made to a special committee of Toronto City Council on March 17 last, I thought I was only doing right, with the experience and knowledge I possessed of the subject in England, to say a few words that would help the public to judge intelligently for themselves in Canada. Being a British subject and living until lately on the tight little islands of England and Ireland, I naturally supposed that the general public of a British colony possessed certain lawful rights of criticism, and that when a drummer made an offer to sell goods to the representatives who had to pay the bills, that the public or any single individual might point to errors, or discuss the value of goods or systems offered to the public without being threatened by the vendors or their agents. I suppose Mr. McDougall will bring Chas. G. Horetzsky, C. E., to task in the same way for the letters he has published in the London, Ont., Advertiser on the same subject. I think it is now time that Mr. McDougall and his principals proved at least one-tenth of the statements which they make in their printed pamphlets about the efficiency of their systems now working in Great Britain, and any Canadian municipality that wishes to protect the health and interests of its constituents should at least have wisdom enough to send an experienced and disinterested person to England to investigate a system upon which it proposes to spend thousands of dollars. It is now in Mr. McDougall's power to prove to the public and the press whether he or I am the biggest coward, and whether the system which he is pushing is an efficient purification system or a financial success.

H. L. McKinstry.

Toronto, July 20th.

NEWFOUNDLAND COAL.

Very favorable accounts have been received from the new coal mines near Grand Lake, Newfoundland, now being opened and worked under the Reid contract. Extensive borings have been made on three of the seams resulting most satisfactorily, the quality of the coal being excellent, and the thickness of the seams increasing. The Imperial Institute, in a circular recently issued, furnishes the results of an analysis of this coal. A small sample, about three ounces, had been sent to the institute from the 6 feet seam for analysis. The circular states that the coal was found to be bright, clean and tough, presenting an irregular conchoidal fracture, and the following results on analysis :—

Fixed carbon	47.19
Ash	10.82
Coke	58.01
Volatile matter	41.99
Sulphur	.735
Calorific value	6347.

The sample caked fairly well, furnishing a coherent, somewhat brittle, coke. The ash is nearly white. This will probably prove to be a good heating coal of fair quality, containing very little sulphur, though rather a low proportion of fixed carbon.

Number two sample from 2½ feet seam weighed about two ounces. The coal was dull, rather brittle, but clean and not dusty. The analytical results were as follows :—

Fixed carbon	49.32
Ash	13.05
Coke	62.37
Volatile matter	37.63
Sulphur	.62
Calorific value	6435.

The coal burns slowly and cakes fairly well, furnishing a somewhat brittle coke. The ash is gray. This coal closely resembled the former sample. It must be remembered, too, that these are almost surface specimens and the coal is likely to improve as the mine deepens. Should the coal seams develop according to expectations it is needless to say that the benefit to the colony will be immense.

—In a lecture before the London Chamber of Commerce, Wm. Ogilvie spoke very plainly about the way in which his name and his reports had been used by promoters for their own ends. He said : "My name has been quoted pretty prominently in a great many prospectuses, and I have been made to say a good many things that I have never said at all. I simply say this as a warning : Do not pay the slightest attention to any extracts from my reports. They may be correct quotations, but they are often misleading. I have no interest in any company ; my sole object is to benefit my own country, Canada, and the Empire of which it is a portion."

MINERAL PRODUCTION OF THE UNITED STATES IN 1897–8.

(PRELIMINARY STATEMENT.)

Compiled for THE MINERAL INDUSTRY, Vol. VI.

By Richard P. Rothwell, editor of the *Engineering and Mining Journal.*

Number.	Products	Customary Measures.	1896. Quantity. Customary Measures.	1896. Quantity. Metric Tons.	1896. Value at Place of Production. Totals.	1896. Value at Place of Production. Per M. Ton.	1897. Quantity. Customary Measures.	1897. Quantity. Metric Tons.	1897. Value at Place of Production. Totals.	1897. Value at Place of Production. Per M. Ton.
	NON-METALLIC.									
	Abrasives:									
1	Carborundum	Sh. T.	595	539	$365,612	*j*$0.68	621	563	$153,812	*j*$0.27
2	Corundum	Sh. T.	250	227	35,000	154.19	230	209	32,200	154.07
3	Crushed steel	Sh. T.	326	296	50,624	171.00	324	294	51,824	176.00
4	Diatom. earth	Sh. T.	3,540	3,211	34,200	10.65	3,000	2,721	30,400	11.17
5	Emery	Sh. T.	1,550	1,406	108,500	77.17	1,500	1,361	105,000	77.15
6	Garnet	Sh. T.	2,440	2,214	85,400	38.57	2,260	2,050	79,100	38.57
7	Grindstones	Sh. T.	31,301	28,396	291,338	10.36	36,651	33,250	366,675	11.00
8	Pumice	Sh. T.	*Nil.*	.....	.....	.....	1,700	1,542	8,500	5.51
9	Quartz crystal	Sh. T.	6,000	5,432	16,500	3.04	6,000	5,432	16,500	3.04
10	Tripoli	Sh. T.	1,405	1,275	4,823	3.79	1,631	1,479	5,475	3.70
11	Whetstones	.....	.....	.....	105,201	.....	.....	.....	80,220	
12	Alum	Sh. T.	14,090	12,782	422,700	33.07	15,456	14,021	463,680	33.07
13	Aluminum sulphate	Sh. T.	42,240	38,319	1,056,000	27.56	46,355	42,053	1,158,875	27.56
14	Ammonium sulphate	Sh. T.	257	233	10,280	.....	3,111	2,822	124,440	.....
15	Asbestos	Sh.T.	716	650	12,670	19.49	770	698	15,400	22.06
16	Asphalt	Sh.T.	20,414	18,519	362,590	19.58	27,397	24,854	486,620	19.58
17	Asphaltic limestone	Sh. T.	5,000	4,536	55,000	12.12	2,390	2,168	11,450	5.28
18	Bitumin's sandstone	Sh. T.	51,956	47,134	132,500	2.81	41,185	37,363	125,555	3.36
19	Barytes	Sh. T.	21,900	19,867	87,600	4.41	27,316	24,781	109,264	4.41
20	Bauxite	L. T.	17,096	17,369	42,740	2.46	20,590	20,919	41,180	1.97
21	Borax (crude)	Sh. T.	13,320	12,084	266,400	22.04	19,400	17,599	388,000	22.05
22	Bromine	Lb.	559,285	253	143,074	*j*0.57	487,149	221	136,402	*j*0.62
23	Calcium carbide	Sh. T.	860	780	48,000	61.54	1,925	1,746	134,750	77.17
24	Cement, nat. hydraul.	Bbls *a*	7,407,311	1,007,980	4,385,962	4.35	7,781,377	1,058,883	4,127,124	3.90
25	Cement, Portland	Bbls *b*	1,577,283	286,181	2,502,479	8.74	2,272,971	412,405	3,578,839	.....
26	Cement, slag	Bbls *c*	*Nil.*	.....	.....	.....	40,000	6,350	60,000	9.45
27	Chrome ore	L. T.	702	713	7,775	10.90	50	51	550	10.78
28	Clay products	Sh. T.	.....	.....	65,000,000	.....	.....	.....	*q*60,000,000	.....
29	Coal, anthracite	Sh. T.	48,133,930	42,667,101	86,682,749	2.03	52,645,133	47,759,665	85,857,717	1.79
30	Coal, bituminous	Sh. T.	139,468,659	126,525,967	113,401,602	0.89	147,557,599	133,864,599	120,505,982	0.89
31	Coal, cannel	Sh. T.	54,661	49,588	146,491	2.95	56,511	51,267	153,145	2.98
32	Coke	Sh. T.	10,369,015	9,406,770	17,311,823	1.84	12,742,340	11,563,673	23,367,879	2.02
33	Cobalt oxide	Lb.	12,825	*j*5,817	17,314	*j*2.98	19,300	*j*8,754	32,810	*j* 3.75
34	Copperas	Sh. T.	11,170	10,133	52,662	5.19	11,924	10,818	56,565	5.23
35	Copper sulphate	Lb.	48,732,840	22,150	1,953,225	88.18	51,012,945	23,139	2,040,518	.....
36	Feldspar	L. T.	24,907	25,305	124,251	4.91	20,900	21,234	113,773	5.36
37	Fluorspar	Sh. T.	6,000	5,432	48,000	8.83	9,025	8,187	74,456	9.09
38	Fullers earth	Sh. T.	11,326	10,275	68,476	6.66	17,049	15,467	91,634	5.93
39	Grahamite (*k*)	Sh. T.	1,282	1,163	38,460	33.07	1,756	1,592	52,680	33.09
40	Graphite, crystalline	Lb.	405,006	*j*183,709	18,225	*j*.10	993,138	*j*450,487	44,691	*j*.10
41	Graphite, amorphous	Sh. T.	574	520	3,850	7.40	1,200	1,090	11,400	10.45
42	Gypsum	Sh. T.	195,553	177,405	583,136	3.29	223,061	202,360	711,952	3.52
43	Iron ore	L. T.	16,000,056	16,256,057	31,200,889	1.93	18,316,967	18,610,038	31,138,844	1.67
44	Litharge	Sh. T.	6,500	5,897	540,300	91.57	9,900	8,981	899,100	100.11
45	Magnesite	Sh. T.	2,067	1,875	9,715	5.12	1,907	1,730	7,628	4.41
46	Manganese ore	L. T.	162,526	165,126	339,083	2.05	156,787	159,296	332,700	2.09
47	Mica, ground	Sh. T.	570	517	9,687	18.73	2,692	2,442	38,218	15.65
48	Mica, sheet	Lb.	17,630	*j*7,997	12,528	*j*1.57	92,335	*j*41,883	45,615	*j* 1.09
49	Mineral wool	Sh. T.	5,853	5,309	61,614	11.60	5,667	5,141	45,494	8.81
50	Monazite	Lb.	17,500	8	875	109.37	40,000	18	2,000	111.11
51	Natural gas	.....	.....	.....	10,000,000	.....	.....	.....	10,000,000	.....
52	Paints, metallic	Sh. T.	31,865	28,908	342,167	11.15	36,293	32,925	370,594	11.26
53	Paints, ocher, etc	Sh. T.	17,835	16,179	178,793	11.05	11,151	10,116	110,165	10.89
54	Paints, venetian red	Sh. T.	5,998	5,309	93,586	17.62	4,596	4,169	55,690	10.96
55	Paints, white, red ld.	Sh. T.	95,955	87,049	7,868,310	90.39	103,235	93,654	9,291,150	99.21
56	Paints, zinc oxide	Sh. T.	15,863	14,391	1,189,725	82.67	26,262	23,825	2,100,960	88.18
57	Petroleum (crude)	Bbls *d*	55,254,795	7,730 425	65,753,206	8.50	56,985,643	7,972.579	44,804,962	5.62
58	Phosphate rock	L. T.	937,372	952,370	2,812,116	2.95	906,080	920,577	2,718,240	2.95
59	Precious stones	.....	.....	.....	200,000	.....	.....	.....	101,000	.....
60	Pyrites	L. T.	109,282	111,030	292,626	2.63	128,468	130,523	379,699	2.83
61	Salt	Bbls *e*	15,707,908	1,995,017	5,328,250	2.67	13,153,524	1,670,592	4,859,364	2.91
62	Silica, sand & quartz	L. T.	720,399	731,925	1,076,038	1.47	750,000	762,000	1,125,000	1.48
63	Slate, roofing	Sq'es.	699,100	.....	2,260,862	*n*3.23	895,372	.....	2,695,580	*n*3.01
64	Slate, manufactures	.....	.....	.....	467,578	.....	.....	.....	547,645	.....
65	Soapstone	Sh. T.	14,350	13,018	143,500	11.02	18,974	17,213	189,740	10.91
66	Soda, natural	Sh. T.	3,000	2,722	65,000	23.88	5,000	4,536	110,000	24.25
67	Soda, manufactured	M. T.	.....	157,475	3,621,925	23.00	.....	277 ,072	5,774,656	20.84
68	Stone, for building	.....	.....	.....	30,599,804	.....	.....	.....	30,000,000	.....
69	Stone, limestone (flux)	L. T.	3,794,173	3,854,882	1,669,437	0.43	4,247,688	4,315,651	1,868,983	0.43
70	Strontium sulphate	Sh. T.	*Nil.*	.....	.....	.....	40	36	200	5.55
71	Sulphur	L. T.	3,800	3,861	72,200	18.70	1,690	1,717	34,814	20.27
72	Sulphuric acid	Sh. T.	1,019,501	924,885	17,331,517	18.74	1,128,741	1,023,987	21,446,079	19.19
73	Talc, common	Sh. T.	7,098	6,439	63,585	9.87	9,563	8,675	82,795	9.54
74	Talc, fibrous	Sh. T.	51,810	47,007	256,080	5.45	58,836	53,376	288,185	5.39
75	Uranium ore	Sh. T.	*Nil.*	.....	.....	.....	17	15	9,010	600.66
76	Zinc ore, exported	L. T.	2,324	2,361	47,408	20.08	9,251	9,399	211,350	22.48
77	Est. prod. unspecified	.....	.....	.....	5,000,000	.....	.....	.....	5,000,000	.....
	Total non-metals	.....	.....	.....	484,999,136	.....	.....	.....	481,692,497	.....
	METALS.									
78	Aluminum	Lb.	1,300,000	*j*589,676	$520,000	*j*$0.85	4,000,000	*j*1,814,400	$1,400,000	*j*$0.77
79	Antimony	Lb.	1,226,000	556	84,717	152.37	1,500,000	680	107,250	157.72
80	Copper (*m*)	Lb.	479,806,183	217,639	51,003,397	234.35	510,190,719	231,421	56,325,055	243.39
81	Gold	Oz. *f*	2,558,433	*j*79,576	52,886,209	*j*664.60	2,864,576	*j*89,092	59,210,795	664.60
82	Iron, pig	L. T.	8,623,127	8,761,097	91,577,610	10.45	9,652,680	9,807,123	92,677,312	9.45
83	Iridium	Oz.	.....	.....	.....	.....	20.25	.....	606	.....
84	Lead, value at N. Y.	Sh. T.	174,792	158,479	10,411,643	54.07	197,718	179,368	11,784,093	65.73
85	Nickel	Lb.	17,170	*j*7,788	4,464	*j*0.57	33,700	*j*15,286	11,668	*j*0.76
86	Platinum	Oz. *f*	200	*j*6.21	2,800	450.89	200	*j*6.21	3,000	482.39
87	Quicksilver	Flks *g*	29,863	1,036	1,104,997	1066.58	26,079	965	991,002	1026.94
88	Silver, comm'l value	Oz. *f*	58,488,810	*j*1,819.208	39,245,992	*j*21.58	56,457,292	*j*1,756,004	33,755,815	19.22
89	Zinc	Sh. T.	77,637	70,432	6,117,796	86.86	100,387	91,070	8,271,889	90.83
	Total metals	.....	.....	.....	252,959,625	.....	.....	.....	264,538,485	.....
	Grand totals	.....	.....	.....	727,958,761	.....	.....	.....	746,230,982	.....

(*a*) Barrels of 300 lb.; (*b*) 400 lb.; (*c*) 200 lb.; (*d*) 42 gal.; (*e*) 280 lb. (*f*) Troy ounces. (*g*) Flasks of 76½ lb. (*h*) Bituminous coal includes brown coal and lignite. The anthracite production is the total for Pennsylvania, Arkansas, and Colorado. (*i*) Estimated. (*j*) Kilograms or per kilogram. (*h*) Including bitumen from Texas. (*m*) The value of the copper production is calculated at 0.25c. per lb. less than the average price of Lake copper at New York. (*n*) Value per square. (*p*) Value per cubic foot. (*q*) This figure is only approximate and will be revised.

Abbreviations: Sh. T., short tons (2,000 lb.); L. T., long tons (2,240 lb.); M. T., metric tons (2204.6 lb.); Sq'es, squares (100 sq. ft., lapped and laid).

UNITED STATES MINERAL PRODUCTION IN 1897.

We give in the accompanying table the completed statistics of the production of minerals and metals in the United States, as collected and arranged for Volume VI of "The Mineral Industry," which is now in press. The total value of the mineral production of the United States in 1897 was, therefore, $746,230,982, against $737,958,761 in 1896. The values given are generally at the mine or works; but with a few of the principal metals—such as lead, copper or zinc—this is not possible, and their values are taken at the leading markets. The total value of the output in 1896 exceeded that of the mineral and metal production of all continental Europe, and nearly doubled that of the United Kingdom, the value of whose mineral output in 1896 was, in round figures, about $340,000,000, while that of Germany was about $300,000,000, that of France about $110,000,000, and that of Belgium $100,000,000.

Deducting necessary duplications, we find that the total value of the production of the United States in 1897 reached the sum of $678 966,644.

This output is limited entirely to ores and other substances mined in the United States and to metals reduced from those ores. In addition there was also a large quantity of metals reduced or refined in the United States from imported ores or base bullion. These are chiefly sent here for treatment from Canada and Mexico. The total production of this class reported was 584,983 ozs. gold; 40,218,776 ozs. silver; 26,938,254 lbs. copper; 4,099,390 lbs. nickel; 92,117 short tons lead; the total value of these metals being $47,127,174. This output of metallurgical works is altogether additional to that recorded in the table. These metals were obtained chiefly from ore, bullion, furnace products and silver-lead imported from Mexico, Newfoundland and Canada. A comparatively small amount of gold and silver ore and bullion comes from Central and South America. Also there was received a large amount of pyrites from Spain and Portugal, all of which contains a little copper. From British Columbia and Mexico came chiefly lead-bearing ore and silver-lead, from which a large part of our lead supply is obtained. The nickel is all from ores or matte produced by the mines at Sudbury, Ont. We have not included in the above quantities the iron smelted from foreign ores, which is small in actual amount and insignificant in comparison with the total output; nor have we included the manganese in foreign ores which enters into the composition of the spiegeleisen and ferro-manganese that is made in the United States. The lead industry is the one most affected by the foreign material that is imported, the quantity of copper being comparatively small.

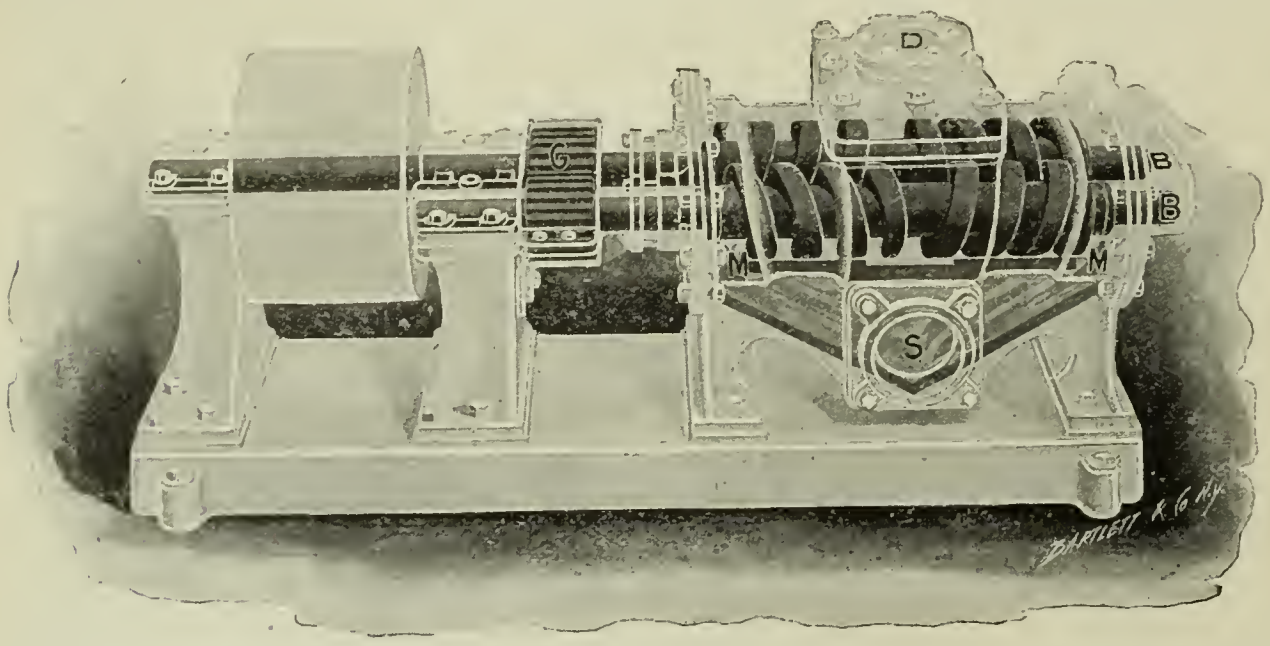
We have given the production of the different articles in metric tons (or kilograms in the case of precious metals), as well as the customary measures, for the reason that the metric measures are those recognized and used by almost all of the civilized world, and are rapidly gaining recognition in the few remaining countries which have not yet fully adopted them. In the United States they are already legalized, with the prospect of their compulsory and exclusive use at an early date. How desirable such a change will be can be best appreciated by those who have had occasion to collect or use statistics of this kind.

THE QUIMBY SCREW PUMP.

By W. T. Bonner, Montreal.

The novel feature of the pump is its simplicity, utilizing as it does a very simple mechanical principle in a very unusual manner for performing useful work.

As will be noticed by an inspection of the accompanying illustrations, the Quimby pump consists of two parallel shafts, on which are mounted the four screws that act as pistons in propelling the water, so arranged that in each pair the thread of one screw projects to the bottom of the space between the threads of the opposite screws. The screw threads have flat faces and peculiarly undercut sides; the width of the face and

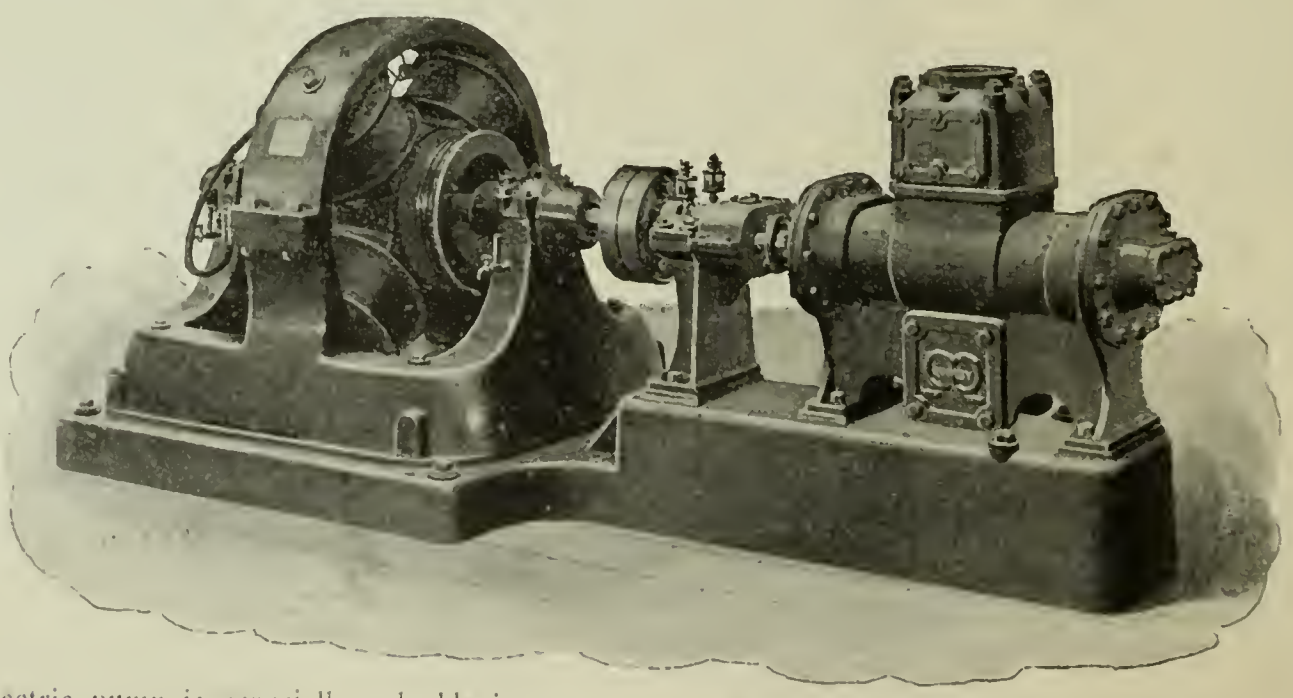


the base of the thread being one-half the pitch. The pump cylinder fits the perimeters of the threads, as shown in figure 2. Space enough is left between the screws and the cylinder and between the faces of the intermeshing threads to allow a close running fit without actual contact. There is no end thrust of the screws in their bearings, because the back pressure of the column of liquid is delivered to the middle of the cylinder, and the endwise pressure upon the screws in one direction is exactly counterbalanced by a like pressure in the opposite direction. The suction connection is shown at S in Fig. 1, and opens into a chamber underneath the pump cylinder. The power to drive the pump is applied to one of the shafts, and the second shaft is driven by means of a pair of gears, shown at G in Fig. 1. The pump has no internal packing, no valves, and no small moving parts.

used in connection with the gravity system, the pump section is connected with the lower discharge tank, and the discharge from the pump is elevated into the roof tank. The pump is controlled by means of a float in the discharge tank, and a starting box.

The Quimby electric pump, when applied to an elevator, can be automatically operated, thus doing away with the constant care and attention required by a steam pump. Whether operated by belt or direct connected to electric motors or steam engines, the Quimby pump has many advantages. For waterworks, oil refineries, or other service where liquids are pumped through long pipe lines, any pulsation in the delivery adds to the difficulty of maintaining tight joints. The Quimby pump, however, has an absolutely pulseless delivery, and at the same time a very high efficiency. Long series of tests show an average efficiency of more than 55 per cent. from wire to water. In many instances tests have shown as high as 65 or 66 per cent. efficiency.

The pump will readily handle thick products, such as paraffine, hot tar, pitch, white lead, melted sugar, glucose, soap, lard, etc. For this service, reciprocating pumps are not desirable, for the reason that heavy liquids are likely to be churned by the action of the plungers, and the friction of the material passing through the valves and ports, greatly reduces the capacity and efficiency. Altogether the Quimby pump appears to offer a wider range for the utilization of electric power than any other apparatus presented for some time past and in a field also where cost of installation and operation are both very important factors.



The Quimby electric pump is especially valuable in connection with the hydro-electric operation of elevators. When used in connection with the pressure tank system, the suction is connected with the elevator discharge tank, the pump discharging into the pressure tank. The pump is controlled by means of a pressure regulator and starting box. When the pressure in the tank falls, the regulator operates the starting box and the pump runs until the pressure has been restored in the tank to the required number of pounds. By the peculiar construction of the Quimby pumps there is no pulsation. When

*Extract from a paper read before the Canadian Electrical Association.

W. Edmonds, contractor, has begun the brick work of the addition to McDougall's foundry, Galt, Ont.

The output from the Chicoutimi, Que., pulp mills is to be exported from Quebec, a steamer being loaded every second week.

The Brockville, Ont., city council has purchased a site for the factory of the Brockville Provision and Packing Company. Plans and specifications are being prepared by Montreal and Chicago experts, and an extensive plant including first-class cold storage facilities will be installed.

THE STEAM END.*

BY JAMES MILNE.

In a paper read at a former convention of this association, it was stated that purchasers of electrical apparatus made very careful enquiries as to the efficiency of same, the price being of secondary importance. If this applies to the electrical, why should it not apply to the steam end as well? I am sure that there are very few plants where the proprietors, or those in charge, enquire as to the efficiency of the boilers and engines, the price with these items being the very first consideration, generally. It is very seldom, in specifications for steam plants, that there is anything said about the efficiency of the boilers, or the water consumption per horse-power at the engine. This I consider one of the most important points in connection with the steam plant. There are engines running which are supposed to be first-class and up to date, where the water consumption per horse-power is nearly double what it ought to be, and if the management in some of these plants would go to the trouble of calculating the coal consumption per electrical horse-power at the bus, I am of the opinion that the results obtained would simply astonish them. I, myself, have records of the coal consumption of a plant, together with the total meter readings, extending over a number of years, and allowing for the loss on the line, together with that on the generators, and although the plant was a non-condensing one, yet the records there are not out of the way. In another plant where I was making a two days' test as to the relative values of coal, I found the coal consumption per E. H. P. at the bus just double the former plant, which might be considered high by some. This second plant was condensing. The load was of such a nature as to make the engine very unsuitable for the work.

I am inclined to think that builders of engines should be made to guarantee a certain steam consumption per indicated h.p. at say 25 per cent. over-load, full load and half load, and that tests should be made to determine if the guarantee has been fulfilled. If the guarantee has been more than fulfilled, let a bonus be given to the builders, and if not fulfilled, so much to be deducted for every 1 per cent. below the guarantee; and if it falls below a certain amount, that is to say, the steam consumption exceeds a certain fixed value, the engine to be removed, or the builders to accept a nominal figure for same. I think if means of this kind were adopted we would get engines of a very high order. Engineers, as a rule, are content so long as they get a fine looking card from their engine, but they very seldom from these cards calculate the steam consumption, which is of vital interest. We have quite a large number of good engine builders in the country, but the number guaranteeing their efficiency is very limited indeed; in fact, I am not aware of any. If tenders are invited for a certain style of engine and the tenderers are called upon to guarantee the steam consumption per B. H. P., the party to receive the contract is the one guaranteeing the least steam consumption per h.p. hour, the cost being of secondary importance. After the engine has been installed and run for some time so as to get down to its proper bearing, carefully conducted tests should be made to ascertain if the guarantee has been fulfilled.

The matter of efficiency of boilers is also one of great importance, but it is not so easily arrived at, owing to the difference in coal. At the same time, however, it would not be a very difficult matter to fix on a certain coal for a standard, and to guarantee so many pounds of water evaporated per lb. of that coal. All boilers, I believe, should be sold by the Centennial Standard, and should be capable of developing their rating with easy firing, showing good work with ordinary coal, and should be capable of being forced 50 per cent. above their rating. There was a recommendation something to this effect made by the Committee of Judges at the Centennial Exhibition, the horse power being 34½ lbs. from and at 212 degrees, which is equivalent to 33,305 heat units. We should get an efficiency close on to 80 degrees with good boilers, and this could be roughly determined with anthracite coal, and if we get 12 lbs. of water evaporating from and at 212 degrees, we have approximately this efficiency, the heating value of the combustible being about 14,500 heat units, which is equivalent to 15 lbs. evaporated from and at 212 degrees, therefore 80 per cent of this gives us 12 lbs. With bituminous coals we have not such uniformity, and it is necessary to determine its heating value either by the coal calorimeter or chemical analysis.

After our boilers and engines are installed, we have to face the problem of running them. It has often been stated that men could be got to do anything, men being more easily replaced than machinery, costing practically nothing as it were. I am of the opinion that this is wrong. Cheap men are numerous we know, but are in the long run very expensive. Good men are scarce, and nowhere is this more noticeable than in the boiler room. Good firemen are very scarce, coal shovellers numerous. In my humble estimation, credit is not given to the firemen that should be. If a plant is run fairly economically as far as coal consumption is concerned, the engineer is more apt to get this credit, but as a matter of fact all he does is to turn on the steam and see that the bearings are oiled. Now and again he may walk into the boiler room to ascertain if the fireman is asleep or not. To have good firing the greatest of skill has to be manifested to get the best results from the coal, and where we are dependent on skill to get first-class results we are depending on a very uncertain quantity. Too much latitude is given the fireman in the matter of coal, and he has it in his power to make or lose nearly a dividend for the company that employs him. Attention is being given to this subject by the largest steam users in the country, whereby the duties of the fireman are being greatly relieved by mechanical devices; their action being positive and not dependent on skill, the machines thus taking the place of the brains of the fireman. This you will agree is a great step in advance, and makes central station management very independent regarding firemen.

*A paper read before the Canadian Electrical Association.

IMPULSE WATER WHEELS.*

By J. T. Farmer, Ma E.
(Concluded).

II.—Nozzle .7532 in. diameter. (a) Pressure 75 lbs. per sq. inch. Equivalent head = 175 feet. Discharge = 120 gallons per minute.

Speed.	Horse Power.	Efficiency.
402	3.68	58.5
501	4.10	65.0
618	4.34	68.8
675	4.34	68.9
750	4.33	68.7
770	4.30	67.7

(b) Pressure 100 lbs. per sq. inch. Equivalent head = 235 feet. Discharge = 138 gallons per minute.

Speed.	Horse Power.	Efficiency.
370	4.82	49.4
371	4.86	50.0
475	5.67	58.4
515	5.95	60.7
588	6.20	63.9
654	6.60	67.8
698	6.66	68.6
756	6.88	70.8
815	6.72	69.3
911	6.35	65.6

In connection with the above results it is interesting and important to notice that the highest actual efficiency appears at a speed which is about .9 of that which theoretically should give the maximum efficiency.

A most important difference between an impulse water wheel and a turbine of either the impulse or pressure type is that the construction of the latter allows a larger area of water to be applied to the wheel for the same dimensions of wheel. In the turbine the wetted surfaces bear a much larger proportion to the size of the wheel than in an impulse wheel, and those surfaces in the turbine are constantly in action, while in the impulse wheel their action is intermittent. When the head of water is small a correspondingly large quantity has to be used to give a required horse-power, and in this case the turbine has the advantage of passing a much larger quantity than the impulse wheel. When the head is very large this feature of the turbine becomes a disadvantage, as it becomes a difficult

*From a Paper read before the Canadian Society of Civil Engineers.

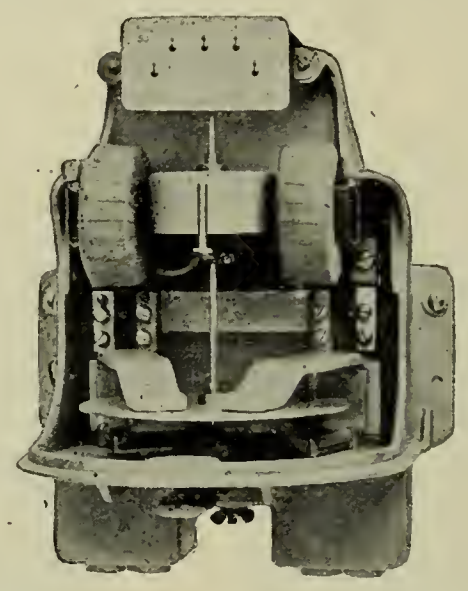
problem to curtail the total discharge of water so that the total power developed may be handled without mechanical inconvenience by the working parts of the motor.

In order to develop considerable power, with a comparatively small head using an impulse wheel, one of two things must be done: either the area of the nozzle and consequently that of the vanes must be made very large, which is only practicable to a limited extent, or else the number of nozzles and wheels must be multiplied. Thus the use of impulse wheels under small heads involves a large amount of machinery for the power obtained. On the other hand, the impulse wheel has many points in its favor, chief among which is its simplicity of construction, which leads directly to the absence of mishaps and to ease of maintenance. The bearings are simple, being merely those on the horizontal shaft, in such a position as to be easily got at when necessary to make any repairs or adjustments. There are no bearings running under water; and the bearings are not subject to any other reaction than that due to the useful effect of the water on the wheel; no difficulty is met with corresponding to that of balancing the static pressure of the water on a turbine, which becomes such an important problem when large heads are being used. The impulse wheel has no watertight joints, as there is no water pressure to be maintained among the working parts. The mechanism also does not contain any parts which are likely to work loose or otherwise become deranged and so lead to trouble.

An important point in determining the practical usefulness of water motors is their adaptability to be run with a fair degree of efficiency under a fraction of the full load. This state of things is generally liable to occur either intermittently, as where a number of loads are being continually put on and off the mechanism driven by the motor; or periodically, as where for portions of a day or week or year the work required from the motor is heavier than at other times. Three methods will be mentioned which are employed to vary the output of work from the wheel. It was mentioned that three nozzle tips of different sizes were supplied with the wheel with which the tests were made. By changing these the quantity of water discharged under a given pressure can be varied as the area of the orifice. The power of the jet will consequently vary in the same ratio; and so any change of load which can be anticipated and will last for a considerable period can be provided for. The changing of the nozzle tips need not be a very difficult operation. It is, however, a very inconvenient plan to have to resort to to regulate the output of power from the wheel. These wheels are sometimes built with several nozzles placed at intervals round the periphery of the wheel. When this is the case the power can be reduced by shutting off the stream from one or more of the nozzles. The third method is to employ a valve or gate in the supply pipe which can be shut off to any desired extent by hand or by some automatic regulating machinery. This method is almost always necessarily employed in addition to those aforementioned. It will be noticed that the effect of the valve to reduce the power is reached by throttling the water as it passes the gate, thus reducing the pressure of the water as it reaches the orifice and consequently reducing also the discharge. It need hardly be pointed out that there is a great loss of efficiency when the motor is running under a light load, as the pressure energy which is not required to drive the machine is all absorbed without useful effect in the resistance of the partially closed valve. An idea of the actual efficiency reached can be gained from a consideration of the foregoing results, obtained for the small nozzle, for the range of heads from 120 to 300 feet. In calculating the efficiencies previously given, the available work was calculated on the assumption that the pressure under which the test was made was the total pressure available. But if that pressure is not the total available pressure as when the pressure is reduced by throttling from 125 to 100 or 75 lbs. per sq. in., then the total available work must be considered to be the product of the weight of water used and the head equivalent to the total available pressure before any throttling took place. In the preceding remarks an attempt has been made to describe and discuss the action of impulse water wheels, and more particularly of the wheel on which the experiments described were carried out: the question of efficiency has been illustrated and examined, and the advantages and disadvantages connected with the use of such a system have been pointed out. It is hoped that these notes may throw some light on this interesting and important subject.

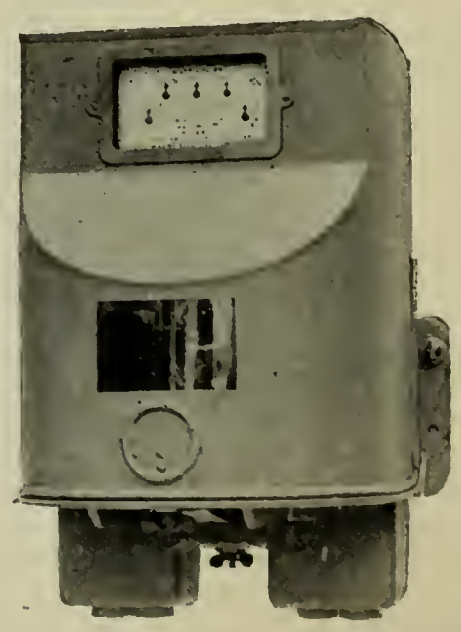
DUNCAN INTEGRATING WATT METER.

This instrument embodies all the essential points that go to make it perfect in every respect. Its operation, like the lamp and ampere hour meters made by the Fort Wayne Electric Corporation and which are giving such good satisfaction, depends upon the induction principle, so that it is very simply constructed and entirely free from any commutator, brushes or other rubbing contacts. It is also the lightest and most compact induction watt meter on the market, so that it is very easily handled and installed. It also has an accuracy on all loads that is excelled by none. When once standardized it will remain accurate for years, this being due to the permanent



magnets forming part of the retarding device being artificially aged by a new process. Another feature that readily recommends it, is a variable friction compensator with which it is equipped. This is something entirely new and provides for cases where the meter should run slow on one lamp after being installed some time, due to the jewel becoming rough. This is a complaint so familiar to the users of electric meters that it does not require to be dwelt upon here. Suffice it to say, however, it does the work and does it well, and without interfering or modifying the speed on any of the other loads. This meter is also applicable to systems having a varying rate of alternations due to uneven speed of the motive power, registering with extreme accuracy.

The principal elements employed in its construction are: Series coils that are mounted upon a laminated iron core which forms the greater portion of the magnetic circuit; an aluminum closed conductor or armature in the form of an inverted cup; and a shunt or volt coil mounted inside the said aluminum armature. The series coils are traversed by the main currents supplying the lamps or other translating devices, and magnetize the iron core in proportion to the amount of current through them. The volt coil is traversed by a current proportional to the electromotive force of the circuit, and is caused to lag



behind the pressure by the addition of an impedence coil connected in series with it. This lagging or difference of phase between the magnetisms of the series and shunt coils causes them to combine into a common resultant which rotates the aluminum armature with a torque proportional to the watts. To make the speed correct and reliable, an aluminum disc is mounted upon the spindle with the armature and rotated be-

tween the poles of permanent magnets, the resulting action of which gives a speed exactly proportional to the watts or energy passing through the meter. The meter is made by the Fort Wayne Electric Corporation. One of these instruments is being presented to the electrical department of McGill University by the Fort Wayne Electric Corporation. It is a 10-light, 66-cycles, 125 volts kilowatt hour meter.

THE IMPORTANCE OF PROPER METHODS OF ILLUMINATION.*

BY F. A. BOWMAN, A. I. E. E., NEW GLASGOW, N. S.

In the last few years, since the electricity supply business has got beyond the stage of "systems" and controlling patents, there has been accumulated a great deal of most valuable information in regard to improvements in the generating and distributing plant, and to the best methods of realizing in practice the benefits from these improvements. From time to time there have arisen most animated discussions on the best system of rates, and methods of charging for the use of the current. The keynote of these discussions is the fact, brought to light by the accumulated experience of those companies that have been supplying electricity for some years, that the fixed charges grow steadily with the maximum demand on the plant, and that therefore the customers should be educated to use the current as many hours per day as possible. This is a matter of the most vital importance, and every central station man in this association should procure a copy of Mr. Arthur Wright's paper on "The Profitable Extension of Electricity Supply Stations," read before the National Electric Light Association at Niagara last year, and also one on the "Cost of Electricity Supply," read by him before the Municipal Electrical Association in England, and to study them until he knows them by heart.

It should be distinctly borne in mind, especially by the smaller companies, that to do a growing and really successful business, something more is necessary than to merely induce your customer to put in so many lamps and then to get as much pay as you can from him for them. It is now clearly demonstrated beyond a peradventure that the margin of profit is as narrow in the central station business as in any other, if not a great deal narrower, and that even when there is no competition from gas or a rival company the closest economy and best management are necessary to yield a profit to the shareholders and provide for future contingencies. In view of this the manager should realize that he must educate his clientele and give them the best satisfaction in every way. Too many managers are satisfied when they have succeeded in persuading a customer to take a certain number of lights. If in addition they are giving full pressure at the lamps and a reliable service they consider that their duty to both the company and the public is done. Now, this is a wrong principle. Attention should be paid to the purpose for which the light is required. Take for example a shop. The purpose for which it is to be used, its size, the height of ceiling, finish of the walls, kinds of goods to be displayed and sold, arrangement of counters and show-cases—all must be noted and considered. It is useless to attempt to light a modern drug store and a ready-made clothing store in the same way, and expect equally satisfactory results in both cases. The manager should be looked upon as authority on methods of lighting, and if he gives the matter a reasonable amount of attention he very soon will be. He must remember that he is a dealer in light and to be a successful one must know all about it—how it is best used and what are the latest fashions in it. If you go to a tailor for a suit of clothes you expect him not only to sell you the cloth and to make up the suit so that it will fit you fairly well, but you expect him to be able to tell you what are the latest styles and fashions and which of them are best adapted to the purpose for which you want them. Some managers will say, "Oh, I have a class of customers who do not care about fitting up nicely and will not spend money on it. All they want is that I will run the wires in and hang the lamps on cords as cheaply as possible." This man is mistaken. There is no community that will take electric light at all where a decided amount of education cannot be carried out. Education of his customers is a very material part of the work of every successful manager in the electrical business, and is one of the principal reasons why the business cannot be properly carrried on by some one who has a number of other interests to look after as well. The manager must study this question of proper illumination so as to master the main principles necessary to a clear understanding of it. He must study his customers so as to know what their tastes and requirements are. He must carefully watch the advertisements in the technical journals and the catalogues that are so plentifully distributed, and many of which contain accurate and valuable information, and then correspond with the advertisers to see if the articles that strike him as suited to some of his customers can be brought within their reach. Then he must canvass carefully and patiently, and if he fails one year must try again the next, because by that time he will know better how to work, his customers' ideas will have advanced somewhat, possibly prices will have dropped a little. The net result of all this is that he at last secures a contract for fitting up that is a pleasure to him to undertake and gives eminent satisfaction to the customer when done.

When first installing lights in the smaller towns and villages, cheap, but not poor work must be done to get the light introduced, but it should be looked upon as introductory only, and later on an earnest and continued effort be made to weed it all out.

A very common case that arises is that of a customer occupying a shop who is always making trouble about the bills. He has a certain number of lights strewed about without any definite arrangement, one switch to shut off the whole thing when he leaves, no shades, no reflectors, and the shop is half dark when all the lights are on, and if he is on meter and turns off a few to save money he has not light enough to do his work. The result is he is constantly growling himself and making others do the same.

When a case of this kind comes up the manager should go to him and suggest that by rearranging things he can have better satisfaction for less money, talk the matter over and work out a scheme that will put the light just where it is wanted, and add a few switches so that the groups of lights can be readily turned on and off. After the exercise of considerable tact and unlimited patience the customer will begin to be convinced and finally consent to refit. When this is done and the lights placed just where wanted, very possibly lamps of smaller candle power than before can be used on some of them. The result is a well lighted shop, which is a good advertisement for both the customer and company at a somewhat reduced cost to the customer and satisfaction all round.

The fewer lights the customer can install and yet get satisfaction from, the longer hours he will burn them all, and so tend to smooth off the peak of his individual load line. And the cheaper he can do it while still yielding a profit, the better for the company, as he is an advertisement and attracts others. Five customers, each of whom has ten lights and uses them all three or four hours each night, are better than one with fifty lights who uses them all for one hour and then turns off as many as possible.

It must be clearly borne in mind that the candle power of a lamp and the amount of illumination we get from it are two entirely distinct things. The useful illumination is the amount of light reflected back to the eye by the objects on which the light falls, and the quantity and quality of the light so reflected is the important and controlling factor, not the candle power of the source of light. The unit of illumination is the "candle-foot;" that is, a light of one candle power one foot distant from the object to be illumined. This is a comfortable light for reading. The illumination is given by the formula:

$$\frac{\text{Candle power}}{\text{Distance in feet}^2}$$

Thus a 16 candle power lamp 4 feet away gives 1 candle foot of illumination.

The illumination yielded by a certain lamp can be very materially increased by the use of reflectors. The illumination of an object which when below a small light is 1 can be increased to 23 by a paper reflector, to 30 by a white glass one, to 64 by a polished one, and to 260 by a silvered glass hemispherical one. White reflectors throw a very nice soft light and smooth off the edges of the shadows so as to produce a very pleasing effect. In using them it should be remembered that the ordinary law of reflection of light, viz., that the angle of reflection is equal to the angle of incidence does not apply to them; but that the rays of light at whatever angle they may strike the reflector spring off from it in lines perpendicular to its surface. Consequently there should be no attempt at the

*A paper read before the Canadian Electrical Association.

mathematical shapes of optical reflectors, but large flat surfaces must be used. They should always be painted a dead white. The enamelling of reflectors to have a shiny surface is a mistake; they do not give as good an effect to begin with and even the best rapidly lose their gloss.

The following table, due to Dr. Sumpner, gives the reflecting power of various surfaces and shows what a wide variation in the number of lights required for a given illumination may be caused by a change of interior decoration:

White blotting paper	82 per cent.
Ordinary foolscap	70 "
Newspapers	50-70 "
Yellow wall paper	40 "
Blue paper	25 "
Dark brown paper	13 "
Dark chocolate paper	4 "
Plain deal (clean)	40-50 "
Plain deal (dirty)	20 "
Yellow painted wall (clean)	40 "
Yellow painted wall (dirty)	20 "
Black cloth	1.2 "
Black velvet	.4 "

When studying out the lighting of a given place we must consider whether we merely wish for a general sense of the space being nicely or brilliantly lighted, as in a ball room or dining room; or whether particular spots or objects need to be clearly illuminated, as the goods in a shop or the tables in a library.

The most important step to good illumination is to secure to the utmost extent possible that no bright spots or lines of light shall strike the eye. The moment the eye sees the source of light it closes itself up for protection from the direct rays and consequently cannot receive as much of the light reflected from neighboring objects, and therefore does not see them distinctly. The following experiment will illustrate this very clearly: Take a shop with two show windows and hang the lights in one window about the level of the eyes, as is so commonly done, and in the other put the same number of lights in good reflectors close up to the ceiling. Now go across the street and note the result. In the first window the goods on exhibition are fairly well lighted, but it is a discomfort to look at them long and nothing is seen behind them. In the other window the goods are shown up beautifully and you can look at them as long as you wish and at the same time can see right back into the shop and see the goods on the shelves and counters.

In the smaller towns and in many cases in the larger ones the question of getting exactly the best illumination and effect from the lights must be subordinated to that of the cost both of the fitting up and of the current consumed. Also a certain amount of deference must be paid to the ideas of the owners.

Thus in lighting show windows the very best method is to light them from overhead, or from the corners, with lamps in deep and powerful reflectors that will throw the light directly on the goods to be shown and will shield it from everywhere else. If it is necessary for the proprietor to be as economical of light as possible this can hardly be done, as these lamps are useless for general illumination in the shop. In such a case as this clusters under good flat reflectors on the ceiling of the window are best. These show the goods in the windows very nicely, they make the front look much brighter, and at the same time throw a very considerable quantity of light into the front part of the shop where it is most required.

An exceedingly common case is a shop from 20 to 25 feet wide, 40 to 50 feet deep with two show windows, the ceiling being from 10 to 12 feet high, and used for dry goods, tailoring, groceries, etc. A very good arrangement for this is to put a three-light cluster and flat reflector in each window, and three similar three-light clusters down the centre of the shop. The main switch should be placed at a convenient spot near the door by which the employees enter and will of course turn on all the lights. Another switch should then be arranged to turn off the window lights, and another to turn off two lights in each of the clusters in the centre. This will be found to be a most convenient and economical arrangement for the customer, who can proportion his light to the weather and amount of business doing. While the central station man will find that, if the shop is open in the evenings at all, the whole of the lights will be on long enough to cover the maximum demand, or standing charges.

These clusters should not be more than 10' 6" from the floor; were these lights raised to 15 feet the direct light from them would be reduced one-half, calling for double the number to produce the same illumination, but since in this case the reflection from the ceiling and walls would be somewhat increased, probably an increase of 50 per cent. in the number of lights would be sufficient.

Drug stores generally call for special treatment, and the lighting must be made to harmonize with and to show off the fittings. Brackets on the top of the shelving and a handsome electrolier in the centre are generally very acceptable, but as the result desired is more in the way of brilliant effect than of mere illumination for the showing of goods, each case must be studied out to suit the purse and the tastes of the persons concerned.

In the matter of churches the great desideratum is the even distribution of the light, with absence of shadows and the total avoidance of all spots or lines of light that will strike the eye of the congregation, or of the minister, especially during the sermon. The minister, the choir and the organist of course require plenty of light, and it often calls for considerable ingenuity to supply their needs without having a bank of lights most unpleasant to the congregation. If such a group of lights cannot be avoided it should be provided with a switch within convenient reach so that it can be turned out during the sermon. In Anglican and Roman Catholic churches which have chancels separated by an arch from the main body of the building, the lights can often be arranged on this arch so as to be entirely hidden from the congregation and yet throw a very pleasant light on the choir and reading desks.

Lodge rooms should be well lighted, and as they are often finished in very dark colors this is a difficult matter. The lights should be divided into groups controlled by switches, and those at the desks of secretary and treasurer are often wanted to be independent of the others in the room. A dimmer is a valuable addition and should be arranged to control all the lights except those just mentioned. It should be a regular theatre dimmer of ample capacity. Lodges are not as a rule paying customers because their use of the light is irregular and the income per light from them very small. Nevertheless it pays to give a good deal of attention to the fitting up of them, because many get educated to good lighting through them whom it would be difficult or impossible to reach in any other way. It will require a good deal of work to get the first one well done and especially to get the dimmer introduced, but after that it will be comparatively easy.

SOME NOVELTIES IN SWING BRIDGE CONSTRUCTION ON THE TRENT VALLEY CANAL.*

By R. B. Woodworth.†

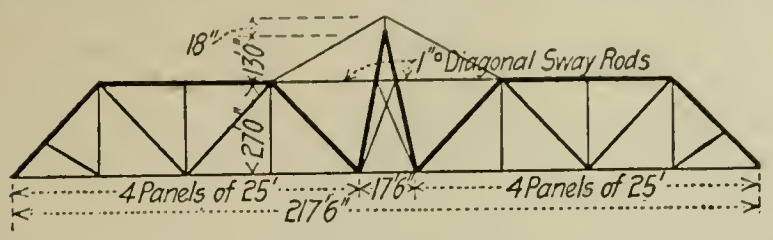
The Trent Valley Canal, now in process of construction by the Dominion of Canada, is projected to extend from Georgian Bay through the province of Ontario to Lake Ontario, and is expected to be of great public value as a waterway. Its construction has naturally demanded numerous high-level and swing bridges.. Several of these were erected during the past year by the Central Bridge & Engineering Co., of Peterborough, Ont., and the purpose of the present paper is to describe certain peculiarities in the construction of the two more important of these, in the design and detail of which the present writer was directly interested.

These were the swing bridges to carry the Grand Trunk Railway over the canal at Nassau, Ont., and the Canadian Pacific Railway over the canal at Ashburnham, Ont. The former had a clear span of 217½ feet c. to c. of end lifts, and the latter a span of 187 feet c. to c. of end lifts. Both were of the same general design, riveted lattice trusses with minor differences due to the different lengths of span and the idiosyncracies of the men who framed the new Canadian tariff. When the material for the long span was ordered angles were most economical; when we came to detail the short span the tariff had made it preferable to use channels. Both were figured for the loadings given under Class II. of the 1896 specifications of the Department of Railways and Canals, viz.: the dead load of the spans themselves, cross ties, rails, etc., at 500 lbs. per lineal foot of span, and a rolling load of two 112-ton locomo-

*From the Engineering News.

†Draughtsman Carnegie Steel Co., Pittsburg, Pa.

tives with a uniform train load of 3,000 lbs. per lineal foot. For the longer span this gives a loading on the turntable, when the bridge is swinging, of about 800,000 lbs. The general style

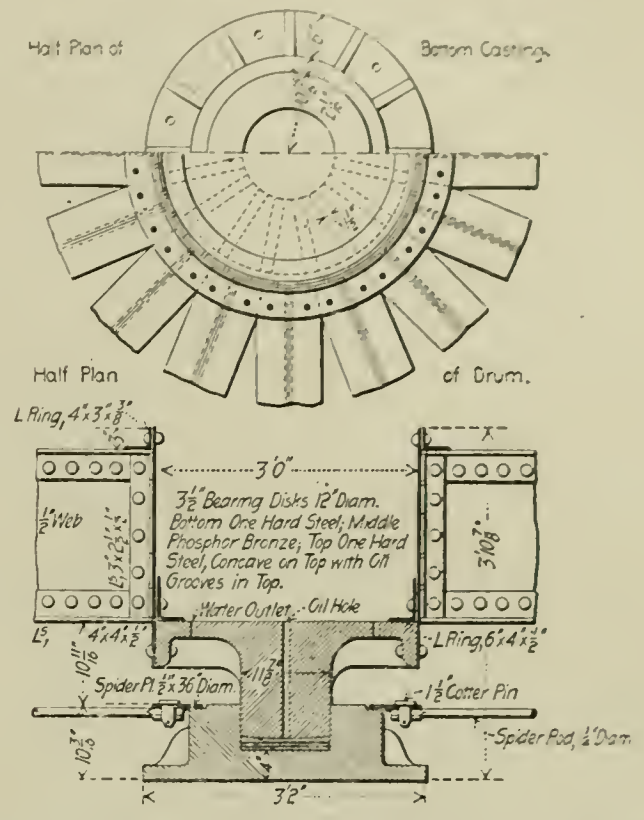


of construction is shown in the diagram, Fig. 1, and need not detain us except to say that all connections were riveted with the exception of the top laterals and the pin connections for the eye-bars and sway-rods connecting the trusses to the central tower. The peculiarities of the construction were three: The turntable centre, the central tower, and the end lifts. The design of the latter is the especial property of W. H. Law, of Toronto, at that time the engineer and manager of the company. The device is based on the use of the toggle-joint, is very simple to construct, and most effective in operation.

Central Tower.—In most swing bridges of ordinary types, whether rim or center bearing, we have to do in the ultimate analysis with beams of complete or partial continuity, and have to take care of shearing stresses transmitted across pivot or drum, and provide special devices to prevent hammering of the truss ends. In the bridge under consideration the rolling load can produce stresses only in the span on which it may be; and the trusses when closed may be figured as simple spans resting on their own supports and completely discontinuous. The turntable is surmounted by a braced tower, Fig. 2, on which rests forged steel links turning on 4 15-16 inch pins, and themselves carrying similar pins to receive the ends of the eye-bars. When the bridge is closed these eye-bars can receive no stress; when the bridge swings, the trusses are simply hung by them to the central tower—a form of construction most simple, effective and economical, easily computed and most practicable in the shop.

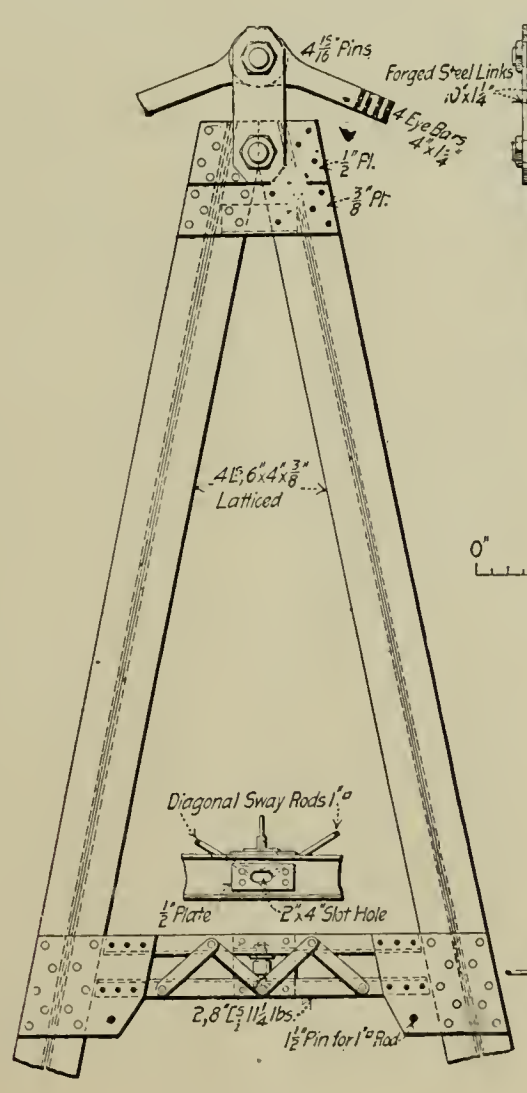
It is quite possible, of course, that by some accident or other —a knock from a boat, say—the links at the top of the tower might be drawn over so far to one side as to fail to return to their normal position when the bridge is swung back to its position when closed. To obviate any mishap of this kind, diagonal sway rods 1 inch square are introduced extending from the pins at the hip to the central tower. Here they connect to 2 inch pins which travel in slotted holes 4 inches in length, giving each pin a movement of 1 inch each way from the center. These rods only come into play in the case of accident to the links, and are emergency saieguards and wind braces.

The central portal is double, as shown; one set of bracing acting with the links, the other set giving rigidity to the tower; the whole forming very efficient protection against accidents common to canals as well as against high winds.

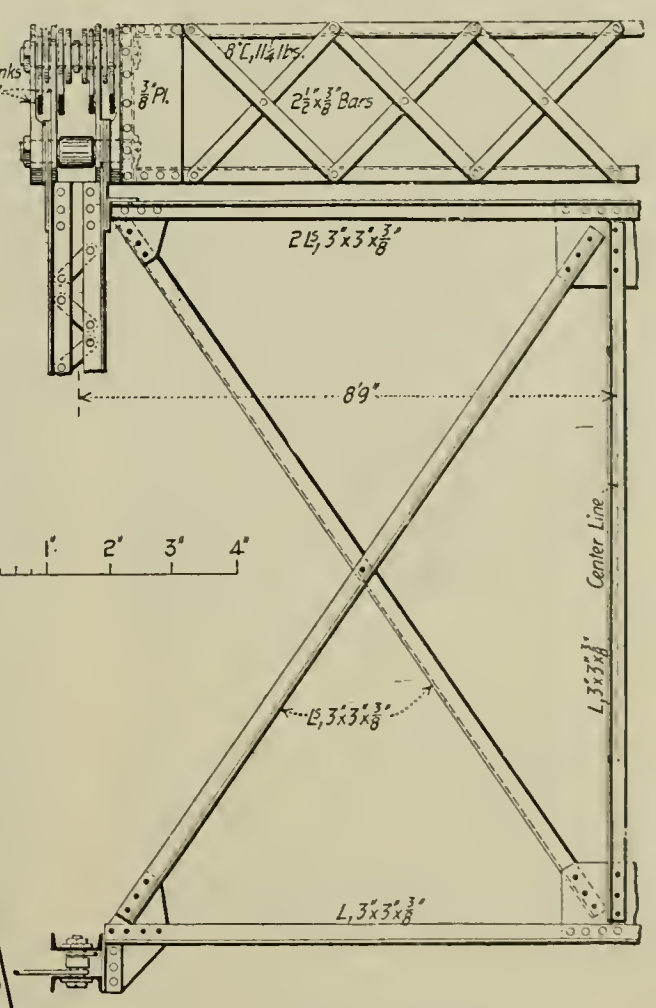


Turntable Center.—This was designed for the express purpose of reducing shop cost by keeping the radial girders of full depth throughout their length. The load from the bridge is delivered to the drum by 16 radial girders which receive it from 8 bearing beams—that is, from 8 points of support. The turntable is combined rim and center bearing—and 250,000 lbs. reach the center, while 550,000 lbs. go to the 36 rollers. The center, Fig. 3, of cast-iron or steel, terminates in its own pin, and the form of construction reduces somewhat the amount of power required to turn the bridge; with this additional feature that the necessity of using bolts is entirely done away with. The steel center plate was riveted to the cast-iron center in the shop and the field riveting was then easily done without any special danger to the center.

The whole structure as thus designed merits attention from the manufacturer's standpoint, and its description may be of use in the further perfecting of shop detail, most centers being



Side Elevation.



Half Transverse Section.

an outgrowth from the design of locomotive turntables, while this is an original creation out of hand.

THE EAST WILL BE EAST AND THE WEST BE WEST.

Editor CANADIAN ENGINEER :

Now that the convention held in Montreal last month is a thing of the past, I desire, whilst congratulating those who helped to make it such an immense success as it undoubtedly was, to draw your attention to one cloud, which though only the size of a man's hand at present might, if allowed to spread, assume dimensions great enough to swamp our whole association. I refer to the action at Thursday morning's session with regard to the matter of inspection, when it will be remembered one of the Toronto delegates, first premising that that city was not interested in the matter at all, proposed a committee of four to deal with the matter, consisting of three representatives of electric plant companies (two of which do not do wiring), and one alderman. I have no fault whatever to find with the gentlemen chosen, but I do object to the very class which of all others are interested, i. e., construction men, not being represented. This was pointed out clearly to the mover, and his courteous seconder even asked to add to the amendment such representative, only to be met with the curt rejoinder, "I persist in my motion." Now at the risk of appearing personal, of which I disclaim any intention, I consider the matter is of too great importance to the association to be "mealy mouthed," and therefore have to say (and I am not the only one), that for any member to carry such high handed proceedings, is a state of things the sooner remedied the better. We have bitter experience of West versus East in our own city without wishing to inaugurate it in our association, but I warn the members that if any clique attempts bull-dozing Quebec Province they will find that she is both able and willing to take care of her own interests, electrical and otherwise.

Whilst not altogether agreeing with the main motion I cannot but favorably contrast the fairness of its mover as compared with that of the mover of the amendment, in offering to withdraw his amendment provided a representative of a construction firm was added to the motion.

If the Toronto delegate's intention was to demonstrate that the association was only in the interests of electric plants, he is treading on still more dangerous ground, as the telephone and telegraph representatives will quickly prove to him, or if again, he intends to arrogate to himself the functions of a little pope he will find his following grow beautifully less, so far as this province is concerned, if he interferes in matters in which, admittedly, he has no interest whatever. I would like to ask you, sir, what is the total membership of the Electrical Association? What proportion of the Executive Committee are Ontario members and what Quebec? Apologizing for thus encroaching on your space.

MONTREALER.

Montreal, July 4th, 1898.

ELECTRIC HEATING.

The inventions that have recently been put on the market by the Dominion Electric Heating & Supply Company, Ltd., of Ottawa, mark a distinct advance in electrical heating apparatus. The appliances manufactured by this company relate not only to house and car heating, but to domestic cooking, laundry work, tailoring and clothing manufacturing, hat manufacturing, and other branches of heating where gas and other fuel have hitherto been in use. A representative of The Canadian Engineer called at their works in Sussex street, and saw water boiled in seven minutes in kettles of a size similar to American electric kettles that require 15 to 18 minutes to bring water to the boiling point. The company guarantee to boil water in seven minutes at a voltage of 110. Like efficiency is obtained in their other heating devices. This high efficiency is attained by a new composition which, paradoxical as it may seem, is at once a good radiator and a good insulator, and which moreover will last infinitely longer than the enamel plates and disks hitherto used in electric heating apparatus. In the heaters hitherto in use all depends on the durability of the enamel. Once that becomes cracked or broken the efficiency of the utensil is soon impaired, and finally destroyed. The conductivity of the ordinary enamel disks is from eight to ten as compared with from fifty to fifty-five of the Dominion Heating Company's discs, which can be heated to a degree that would ruin an enamel disc in a few minutes. A test of one of the Dominion Company's discs was made by a continuous use for over a year night and day at a high temperature, and at the end of this time there was no sign of oxidation in the resistance coil. The composition used by the company has a dark and roughened surface and can be applied in such thin coats that there is very little resistance to heat through, which is one of the secrets of its efficiency. Over 2,000 various heaters have been manufactured by this company, and time is rapidly proving their superiority. The catalogue issued by the company describes electric frying pans, sauce pans, pancake griddles, flexible heaters for water bags, tea kettle heaters, chafing dishes, electric tea and coffee pots, broilers or toasters, cake cookers, portable stoves, glue pots, immersion plates for heating baths or wash water, curling tong heaters, tea and coffee urns, bar water urns, milk heaters, plate warmers, foot warmers, flat iron heaters, goose irons, air heaters for bath and other isolated rooms, electric office heaters, library radiators, as well as car heaters, cooking stoves, etc.

Peter McGregor, inventor of this special composition, was born in Glasgow, Scotland, and began to study electrical depositions and japanning while employed in the Milton foundry in that city. He afterwards learned the pottery business and was employed in Moreland's Castle Espie Works, in the county of Down, Ireland. Coming to Canada in 1873 he started the Ottawa Pottery Works in the following year. In 1879 he was awarded the bronze medal presented by the Princess Louis for original designs in pottery.

FRASER VALLEY RECLAMATION.*

BY R. E. PALMER, A.M. CAN. SOC. C.E.

The freshets or floods of the Fraser River, British Columbia, occur as a rule between the latter end of May and the middle of July, caused principally by the melting of the snow upon the mountains. In the reclamation of portions of the delta lands of this valley, from these freshets, the most difficult part of the schemes at present adopted is the satisfactory design and building of the sluice boxes and flood gates. Up to the present time, that portion of the delta reclaimed lies in patches, each portion being protected by itself, and not connected with any other portion. Generally these patches or valleys front on the main river, and are surrounded on all sides, with the exception of the frontage, by high lands, which discharge all their drainage upon the flats. This water finds its way over these flats through sloughs and creeks which discharge into the main river, during the low or ordinary stage of the water, namely, from August to the end of April.

The system of reclamation adopted up to the present day has been that of the construction of dykes or embankments, of different dimensions, along the banks of the river, from high lands to high lands, and of the building in the creeks or sloughs, over which the dykes would pass, of flood gates, and sluice boxes as they are called, which are so constructed as to close during the high water, preventing the river water from backing up the sloughs and flooding the prairies. They are constructed also to open, so soon as the water in the river begins to fall lower than in the sloughs, and drain the prairies, the sloughs during the period when the gates are closed acting as reservoirs, to hold the ordinary drainage from the surrounding hills. In ordinary cases the sloughs have not enough capacity to hold the drainage during the time when the gates are closed, and pumping has to be resorted to, for about a month in the year.

One of the most difficult operations connected with these schemes is the proper designing and construction of these boxes. It is a very difficult matter to keep them tight, and the material in and surrounding these sloughs is such that when once the slightest leakage occurs, under pressure, it is a very short time until the whole box finds its way into the river or up the slough. Again the many and varied kind of sloughs and creeks, the different classes of material through which they pass, varying from gravel and sand to silt and clay, the fact that some discharge into the river where there is a regular rise and fall due to the tide, while others discharge at points where the tide does not reach—(the gates of the former having of necessity to close and open during each tide, while in the

*A paper read before the Canadian Society of Civil Engineers.

latter they need only close during the freshet)—all tend to require very careful examination and much experience before deciding upon the proper design for the gates. In fact, almost every locality requires a gate of a design unique in itself, with some special features differing probably very materially from that required in a locality not half a mile distant. The boxes required for the sloughs located on the river above the effect of the tides are subjected to a very severe test and strain during high water. They are often subjected to a pressure of water due to a head of from 18 to 20 feet and lasting from a month to six weeks. On the other hand, those located on that part of the river affected by tidal waters are relieved twice every day during ebb tide.

The writer gives a description of two of these boxes built by him, one in March, April and May, and the other in August and September, 1896, all being under the same contract. They are built in two sloughs, discharging into the Fraser, through what is known as the Matsqui Prairie. They were designed in 1893 by Fred. J. L. Tytler, C.E., at present supervising engineer for reclaiming lands for the Provincial Government of British Columbia, and were built with several changes under contract by the writer. It may also be mentioned that in each of these sloughs prior to the construction of the ones described, there had been built three different and distinct boxes, each of which had succumbed to the effects of the freshets, and had been torn apart or scoured out, and carried by the flood for long distances over the prairies. One of the present boxes, the only one built at the time, was subjected to a very heavy freshet in July last, the water in the river reaching to a point only 2 feet 11 inches below that reached during the disastrous flood of 1894; but although the work was barely completed when the flood came, and had in consequence barely reached its true bearing, still there was no sign of leakage, or scour, or damage in any one particular. The lumber used in the boxes was all of rough sound cedar, with the exception of the clappers or doors, which were of dressed Douglas fir. The boxes are identical in design, each being 80 feet long by 26 feet wide by 5 feet 8 inches outside measurement, having four openings each 4 feet by 5 feet. They have also each an entrance apron 30 feet x 40 feet, and a discharge apron 60 feet x 40 feet; each contains about 90,000 feet B.M. All spikes were specified to be galvanized.

The most important part of the work is the method of setting the box, and the proper placing of the brush and clay and pickets, and this will be now described. At this point of the Fraser River, there is an ordinary rise and fall of tide, due to the backing up of the river, of about 4½ feet, while during the freshet no difference of rise and fall is perceptible. Both boxes being identical in design it is only necessary to describe the manner of placing one—the most difficult—and located in what is known as No. 3 slough. This slough is about 80 feet wide at the top, and from 25 to 30 feet deep, with water at the time of construction about 10 to 16 feet deep. It drains a large portion of the prairie, besides receiving a large creek from the surrounding hills, and as the weather was very wet at the time, it was necessary for it or the off-take ditch to carry away a large amount of water. The banks of the slough sloped at about ¾ to 1 and were interwoven with roots, and gave signs of sliding from adjacent springs and seepage of water. The method devised and afterwards adopted for placing the box was to build a temporary dam a short distance above the site of the box, another a short distance below the site, excavate an off-take ditch, and having pumped out the portion of the slough between the dams, to commence operations. The off-take ditch was excavated through fairly good clay, being about 12 feet wide at the bottom, with side slopes of about 1 to 1, and varying in depth from 4 to 14 feet. In constructing the upper dam a crib of logs was first built across, notched down and securely drift-bolted together, the logs on the upper side having a batter of about 6 inches to the foot. Along the upper side were driven sheet piles, consisting of 3 and 4 inches plank which penetrated from 4 to 8 feet into the bottom, but on account of the presence of many sunken logs and stumps, it was impossible to get all the plank down to a proper bearing, but they were intended merely to hold the brush and earth, afterwards conveyed in, from being swept down by the current so soon as it was deposited.

At first it was considered practicable to commence this sheet piling at one side, and continue along, finishing at the other, but it was found that the banks were of such a treacherous nature, that the increased current due to the narrowing of the channel, would scour away the banks more quickly than the sheet piles could be driven, and thus destroy the location of the box. It was then decided to commence at both ends, make them thoroughly secure, and work toward the centre. This was done, the sheet piling from each side being closely followed by laborers dumping earth to form an enbankment on the upper side of the crib, keeping plenty of brush on the outside, to prevent the earth being scoured away by the current. After having proceeded thus toward the centre, and when the current became too strong, due to the narrow opening to hold the earth from being washed oway, the gap in the sheet piling was closed, and the backing deposited as soon as possible. But the material in the bottom of the slough was of such a treacherous nature, that no sooner had the water on the upper side begun to rise on the piling than it broke through underneath, the water following the piles down, where it encountered a coarse, red sand, which was soon scoured out, and in a very short time an open channel was made underneath the piling. Sacks were immediately obtained and filled with earth (about 1,200 of them), and these dumped into the channel or hole with loose hay and earth, finally held the current until a large earth embankment was built across. No more trouble was afterwards encountered, although it was subjected at one time to a pressure due to a 27-foot head. The lower dam was built in much the same way, but with less difficulty, there being only a 4 foot tide to contend against. The specifications required all ooze, logs, sticks or perishable matter to be removed from the bottom of the slough, between the two dams, to a maximum depth of 6 feet below the bottom of the box, in order to secure a proper foundation on which to lay the brush and clay. Should the material below that be soft and mushy, then wild hay was to be tramped in below that again, until a firm bed was obtained. But it was to be left to the judgment of the engineer as to how deep up to the six feet the excavation was to be made.

After having pumped out the location—a centrifugal pump with a 4 inch discharge having been used with a maximum lift of about 15 feet—the bottom of the slough was carefully examined and the material tested. The first 2 feet or thereabouts consisted of ooze, slime, brush, logs, stumps and every imaginable kind of worthless matter. Beneath this for from 4 to 6 feet was a bed of silt, of a bluish color, containing minute particles of mica, and very gritty to the touch, but the particles of sand being fine. This when left in its natural bed, and not disturbed, is impervious to water, but once it is moved and displaced, and exposed to the action of water under pressure, it becomes a veritable quicksand. Beneath this was a bed of fairly coarse, red sand. After having made this examination, the cause of the former boxes having been scoured out was apparent to the writer. They had been constructed in the form of coffer-dams built by driving rows of sheet piles braced to ordinary piles, and filling the intervening space with earth or clay. These piles have penetrated this bluish silt, and were driven into the red sand. When the water acquired the necessary head on the outside, after the closing of the gates, it followed down the piles through the silt, into the sand and up again on the other side. The intervening earth was soon washed out, and with it the bottom of the piles, until a channel was formed underneath, and very little time elapsed before the whole structure was scoured out. After having been enlightened as to the nature of the bottom, it was decided to lay the foundation upon this bed of bluish silt, without disturbing it more than necessary. This was done after all the decayed material—logs, ooze, etc.—had been removed from the bottom, and all roots, slides and loose material cleaned off the sides of the banks, and proper slopes of about 1½ to 1 excavated from them. The foundation under the box proper was built up of clay and brush, that under each apron of rip-rap. The specifications for the clay read as follows: "To be of first-class quality, and when kneaded stiff into a pyramid of an inch or so in height, and immersed in water, will remain intact for 24 hours without crumbling. The brush was to be of green bushy fir or cedar trees, of young growth, not more than 15 feet in length, when the stem is cut close to the head, which it shall be, or limbs similar in character." The separate limbs were afterwards practically excluded, and bush allowed much longer than specified, which served the purpose better. The first intention of the writer was to obtain the clay from a bed about a mile up the slough, above the site of the box; but after

the temporary dams had been built, a great quantity of rain fell, and as the off-take never was intended to carry off all the drainage, the water backed up, so that the clay could not be reached. Another bed of blue clay of excellent quality was then located on the river bank, about two miles below the mouth of the slough, and was conveyed by steamer and scows at a heavy expense.

The foundation was laid as follows: A bed of this clay was deposited on the bottom of the slough about 2 feet in thickness, and 80 feet in length, that is, under the site for the box proper. This was laid in layers a few inches in thickness, carefully spread and levelled, and well tramped and pounded down. On the top of this was laid a row of brush with butts to the end. These small trees were laid close together longitudinally, from one side of the slough to the other, and at one end of the foundation. The branches standing up were "nicked" in order to let them lie close. After the first row was laid, another was placed on top partially covering the first layer, similar to shingling a roof, butts all lying out in the same way as number one row. Then another row was laid in a similar manner, until the layer of clay below (80 feet in length) was covered for about two-thirds the distance from one end, or between 50 or 60 feet. After this had been completed, a layer of clay was laid on top from 1½ to 2 feet in thickness, covering the whole foundation. This was thoroughly compacted, and tramped down with horses and then levelled up. Upon the top of this clay was laid another layer of brush similar to the lower layer, but this time commencing at the opposite end of the foundation butts out, and extending for about two-thirds of the way towards the first end, and thus overlapping a portion of the first layer of brush, but care being taken that there was a good layer of clay between, so that the brush in no instance would be continuous through the entire length of the foundation. Upon the top of this was laid another layer of clay similar to the previous layer and so on, until the proper height was obtained to lay the box. When the foundation reached the required height, it was carefully levelled off and made ready for the box. The lower planks of the box floor (5 x 12 x 26 feet) were then laid close together, each one being levelled up and pounded down with a heavy pounder, until it lay on an even bed throughout, in contact with the clay. Upon the top of this floor was built the box as shown on the plan.

From the box to each bank of the slough was laid clay and brush in a similar manner to that in the foundation, care being taken that in no case should the brush extend in a continuous layer right through the embankment, or that it should touch the sides of the box. The clay was laid in thin layers and thoroughly tramped and pounded down, especially close to the box, and also carefully knitted into the banks on each side by key walls. A brush and clay embankment laid in this manner was carried up on each side and on the top of the box, until the top of the banks of the slough were reached, with the exception that, after the top of the box level was reached, the slopes on each end were carried up by driving split cedar pickets about 3 inches in diameter and 6 inches apart, 4 feet into the embankment—each row being 1 foot higher than the preceding one, and 1 foot nearer the centre of the box, thus making a slope of 1 to 1 at the ends. Behind, or inside each row of pickets, was laid "heading brush" or brush laid transversely with the box to keep the clay in place. From the top of the bank of the slough, a dyke of ordinary earth-work was built to the height of the river dyke, about two feet above maximum high water. The aprons were built as shown on the plan, the walls flaring out from the ends of the box to the end of the apron, and rip-rap being hand laid outside of the walls upon the floor, to load it down. From the rip-rap walls to the banks, the slopes were built of rough brush and ordinary earth, laid in a similar manner to the clay and brush.

The gates or clappers used on the box, are of the "top hung" pattern. A difference of opinion seems to exist among the engineers of this district, as to advantages derived from that style over the "side hung" gate. The trouble experienced with the gates on this box was as follows: when the freshet first begins to come, the river only rises a few inches in 24 hours, and, according to the state of the weather, may in its steady rise exceed 6 to 12 inches in one day. Consequently, the gates not being hung perpendicularly, but when closed have a batter of about 1 inch in 12—the water keeps running in underneath the clapper, filling the slough inside, as quickly or nearly so, as the river rises outside, and the clapper to all intents and purposes floats on the stream, there being practically no pressure against it, at least not enough to close it. Weights were attached to the bottom of the clapper which assisted materially in closing them. In the case where the water rises rapidly outside, as in tidal waters, no trouble is encountered, for once it begins to rise, a head very rapidly forms, and the gates will close with a sound as of the discharge of a cannon. Another disadvantage of the "top hung" gate is this: when the slough is discharging, the water inside as a rule is very slightly higher than the falling water outside. Also there are always more or less branches of fallen trees, sticks, pieces of logs, etc., being carried out through the boxes. These must necessarily pass underneath the slightly opened clappers, and in many cases are caught between the floor of the box and the bottom of the gate. Then when the tide changes, and the water turns to flow back into the slough, the debris prevents the particular gate from closing. Well designed grillages both above and below the gates ward off much of the debris, but notwithstanding this it is impossible to keep some branches, fence rails, etc., from passing through. In the "side-hung" gates, less trouble is encountered from this. Here the gates are hung in pairs, closing at the centre of the openings, the debris can then float upon the top of the water, and not being dragged along the bottom of the box, has only the two edges of the gates to encounter, and the gates being evenly balanced, will open enough to allow the debris to pass through. This difficulty of course is only encountered when the head on either side is small, and the gates in consequence are very slightly opened. In "side hung" gates there is a slight disadvantage in that it is very difficult to prevent the gates from sagging through length of time, which prevents them from closing tightly. They must be well designed with very heavy and strong hinges.

In many of these boxes on the Fraser, the gates are hung on the outside of the box, and have an advantage that they are more easily reached should anything prevent their closing during high water.

These gates cost practically $10,000 each.

SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER.

My attention has been drawn to a letter signed "Expert," which appears on pages 47 and 48 of The Canadian Engineer of June, 1898, containing mis-statements and inaccuracies with respect to the International system of sewage purification, which for ten years has been in this country so successfully used, and adopted in preference to all other methods, and is now being introduced into Canada and America by Mr. J. McDougall. It is evident that "Expert," who prefers to make his assertions anonymously, is not master of the subject on which he writes. His statement that the International Company has changed its filtering process from a continuous flow to an intermittent system, "thereby purifying the sewage by bacteria, which require atmospheric air regularly at short periods," is not correct, as the International Company has always recommended, and was the first to introduce, the now accepted principle that filter beds must be worked on an aerating system in order to ensure the best results. At the present time, by means of valuable patented improvements, we are able to aerate filters every few minutes, and at the same time filter at a much greater speed than any other process, and obtain a far higher degree of purity. "Expert" also makes some rash and totally incorrect statements as regards what he calls "Intricate sludge machinery." The sludge removal apparatus used in the International process is of the most simple and efficient kind, effecting great economy in the construction of sewage works, as its use does away with the necessity of large areas of tanks. The apparatus is used by the British Government, and at a great number of sewage works in this country, and its adoption is rapidly extending, which fact is proof of its success. "Expert" also says the precipitant Ferozone is a "heavy constant and useless expense," and that coal screenings are far superior to Polarite—(the filtering material of the International process). These assertions are so wholly incorrect that it is difficult to understand how "Expert" came to make them unless he wishes wilfully to mislead. As regards the cost of Ferozone,

with modern plant and machinery and with a dilute sewage such as met with in American and Canadian towns, chemicals may be dispensed with altogether, there being sufficient dissolved oxygen in a weak sewage to effect the necessary treatment in the sewage tanks, previous to the final purification through Polarite beds. "Expert" rashly says, "Coal screenings are far more efficient and lasting when used as a filtrate, standing ahead of every other material, except charcoal made from wood or town's garbage." The only advocates of charcoal made from town's garbage are those interested in what was known in England some years ago as the Jagger & Turley system of carbonized refuse, which was tried at a little place called Baildon, the results being given in a paper read by W. Naylor, Esq., F.C.S., chief engineer inspector, Ribble Conservancy Board, and published in The Journal of the Society of Chemical Industry, 30th April, 1894; the following is an extract, and will show the utter absurdity of attempting to deal with sewage by such a system:

"An impression has long been abroad among the local board 'Practical men' that coke is the proper thing through which to filter sewage. Reason and figures are of no avail with a sewerage chairman, who has set his mind on coke. It is an old established institution, handed down from father to son, and will die hard, but die it must, for (as shown by the Nelson figures, Nos. 32 and 33) it has no effect on dissolved organic matter at ordinary filter depths and rates of filtration. This coke, however, was pulled out and burnt during a recent coal famine, doing more good on that particular occasion than it ever did before. Its ghost, however, is now on exhibition at Baildon in the form of a 'Carbon' filter (so-called). Ash pit and privy refuse is here burnt, carbonized, it is claimed, and a filter made of the resulting ash. This forms a sand filter, but that is all, and if of sufficient area would perhaps in time form a nitrification bed. This is a process which at once appeals to the minds and pockets of local boards. No precipitants! No expensive filters! Refuse disposed of! No pollution! The impossibility, however, of its application on a large scale must be apparent at once to any but an outsider. The sewage treated at Baildon by this process is initially very weak. Its effect upon that is a mere screening effect, as shown by the results numbered 34 to 37."*

TABLE OF RESULTS.

No. of sample.	Description of sample.	Taken by	Date	Examined by	Part per 10.000 albumenoid ammonia.
32	Nelson effluent before coke beds	Author	8th Aug., '92	Author	2.0
33	do. after	"	"	"	2.0
34	Baildon raw sewage	"	17th Jan.,'94	"	0.345
35	" tank effluent	"	"	"	0.330
36	" filter	"	"	"	0.150
37	" clear sewage	"	"	"	0.130

It is evident that your correspondent, who styles himself an "Expert," is woefully ignorant, not only of the science of sewage treatment, but of what has recently taken place as regards the system he indirectly advocates, viz., carbonized town garbage, which after trial had to be abandoned at the town of Alton, Hampshire, England. Is not "Expert" connected with this carbonized garbage process. Otherwise his unjustifiable attack on the successful International system cannot be understood. Polarite filters are vastly cheaper than any other form owing to the powerful purifying powers of Polarite, which enables a high rate of filtration to be maintained and an effluent of a much greater degree of purity obtained than by any other system. The best proof of this is the number of places at which Polarite filters are in operation. Her Majesty's Government would not use Polarite in England and send it to all parts of the world for purification purposes, could equal results be obtained by coal screenings, coke or similar substances, which when tried, even on a small and closely watched experimental scale, are found after a short time to choke up and become useless, even when worked at so slow a rate of filtration as to render them enormously costly and altogether prohibitive. Polarite filters on the contrary are most economical and their efficiency is shown by the following, which is the opinion of Major Tulloch, C.B., R.E., late engineer in chief to the local government board, on the Chorley Corporation Sewage Works, where the International Ferozone and Polarite process has been in most successful operation for several years:—

"I am highly pleased with what I have seen. The works are excellently managed and looked after, and reflect the greatest credit on the town council. The effluent from the depositing tanks is among the very best I have seen, almost perfectly clear, and with only a faint smell, while that from the filters is as clear as spring water and perfectly inodorous. These works I consider to be among the very best in the country. I know of none where better results are produced."

In view of the anonymous attack made on the International system by "Expert," I trust that your Canadian sense of fairness will ensure the fullest publicity to this letter, for the length of which I apologize, and remain, yours obediently,

FRANK CANDY,
General Manager.

109 Victoria Street, Westminster, London, England.
July 8th, 1898.

*Reprinted from the Journal of the Society of Chemical Industry of 30th April, 1894. Being a paper called "Comparative results of some modern systems of Sewage Treatment," by W. Naylor, F.C.S., Chief Engineering Inspector to the Ribble Conservancy.

GARBAGE DESTRUCTORS.

Editor CANADIAN ENGINEER:

Our attention has been drawn to a letter signed "Expert" in your June issue, and this gentleman mentions the name of our Mr. Warner and the Patent Refuse Destructor, which we manufacture, and we think it necessary to make some comment upon the matter. It is evident to us that this expert is a very dark horse, as in the first place he does not acknowledge his name, and in the second place, he does not know what he is talking about. If he would give his name, facts and figures it could be handled in a proper engineering manner, but, it may be as well to mention that we manufacture several kinds of destructors, both with forced draught, by steam and air blast and with chimney draught, that we are up to the most recent destructors as regards high temperature, cost of refuse treatment and the amount of steam produced, and as some proof of our statement we enclose a reprint from a recent English newspaper showing that after full investigation our patent destructor has been accepted at the city of Bath, the city of Sheffield, and the town of Plymouth. We have since been informed that the town of Hartlepool has passed our scheme for a destructor of 6 cells, and we are at the present time building destructors in different parts of the country and abroad, consisting of upwards of 150 cells; this, we think, is practical proof that our schemes are not so old-fashioned as made out by "Expert." We can say quite as much with regard to the treatment of sewage as we are at the present time supplying a large number of the most important schemes, and carried out under the most eminent engineers including J. Mansergh, Esq., of Westminster; W. Santo Crimp, Esq., T. de Courcy Meade, Esq., Mr. Leiley, Messrs. Pollard & Tingle, of Westminster, and many other borough engineers. In conclusion we can only say we think "Expert" will have to be a student for many years before he arrives at a possible chance of being a professional man, let alone an expert in matters he is talking about. Yours truly.

GODDARD, MASSEY & WARNER.

Nottingham, Eng., July 15th.

SANITARY PLUMBING.

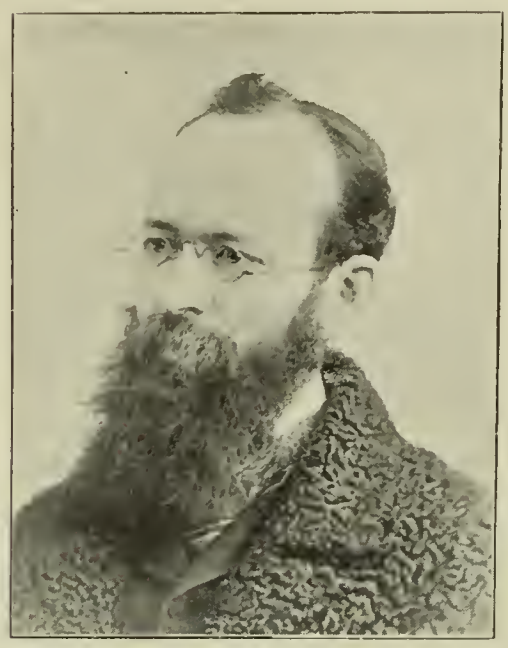
Editor CANADIAN ENGINEER.

I have read with much pleasure W. M. Watson's article on the sanitary experiments at Cologne, and since reading it I have been able to prove the accuracy of the statement that sewage falling vertically through a soil pipe carries down with it several times its own volume of atmospheric air into the main sewer, which is a very important thing and tends to keep the sewers fresh and odorless. I have worked in three of the largest cities in England as a journeyman plumber, where interception traps on private drains or on drains serving rain water leaders were unknown. No more was sewer gas known to enter dwellings or pollute the streets in such quantities as to be injurious or noticeable. I have also worked in Toronto where traps are in general use for such purposes, and when doing repairing work I have found many chokes, and several buildings with the soil under the basement floors completely saturated with the liquid from excrement, which is a mishap that never occurred in any of the towns in which I worked in

England, where sound drains are used. The article has given valuable pointers to thinking plumbers and unbiased citizens who wish to secure the healthiest methods of erecting sanitary appliances. Truly yours, E. A.

Napanee, July 25th, 1898.

WILLIAM HENRY LYNCH.



William Henry Lynch was born at Danville, Que., July 25th, 1847. In his youth he worked as a telegraph operator and was afterwards manager of the old Danville school-slate quarry. When the quarry closed down though the lowering of prices, brought about by American competition, Mr. Lynch turned his attention to the dairy question. Under a strong conviction of the great future before the dairy interests of Canada, and the special suitability of the climate and soil of this country for this branch of agriculture Mr. Lynch began an agitation throughout the country for a reform in the methods then in vogue. From 1881 to 1889 he spent most of his time and money in efforts to arouse the attention of the farmers to the great opportunities before them in the manufacture of butter and cheese for export. He applied himself so intensely to this labor of love that he soon became one of the foremost authorities on dairying. His work attracted the attention of the late Prof. Arnold, of Rochester, who invited him there to carry on experiments in the treatment of milk and the manufacture of butter, and who returned the obligation by coming to Canada to testify to Mr. Lynch's great work in the interests of the Canadian farmer. During this time Mr. Lynch became the author of a book on "Scientific Butter Making," the value of which was manifest by its purchase by the Ontario Government for general distribution among the Ontario farmers. Among the direct results of this work was the establishment of a government creamery, and the incorporation of dairy work as a special department of the Agricultural College at Guelph. "Scientific Butter Making" was followed by "Butter and Cheese," of which 70,000 copies were issued in English and French. The edition was exhausted within a year, and this led to a larger work entitled "Scientific Dairy Practice," which is considered to-day the best hand-book ever issued on this subject, and of which 100,000 copies were printed. During these years Mr. Lynch delivered hundreds of public lectures to farmer's and dairymen's associations, besides addresses to various Boards of Trade throughout Canada. These were delivered without charge and in most cases without even compensation for his traveling expenses, his great work being carried on simply out of conviction of the importance of the subject to the country. That Mr. Lynch looked into the future with a prescient eye is very evident, when we consider the enormous development of the dairy exports of Canada. In 1886 the exports of Canadian cheese amounted to $6,754,620, and of butter $832,355. In 1897 the exports of Canadian cheese amounted to 164,220,699 lbs., valued at $14,676,239, and of butter to $2,089,173. To see what was being accomplished by other countries, Mr. Lynch made a tour at his own expense through Great Britain, Denmark, Norway, Sweden, Holland and Germany, and gave the results of his knowledge to the public in a series of interesting letters, written also without charge, to the leading Canadian papers. He had all along urged federal action by the Canadian Government to promote the export of dairy products, and closed his letters by a call to Canadian dairymen to meet in a convention at Ottawa. The immediate outcome of this convention was the appointment of a Dominion dairy commissioner, and the organization of the governmental machinery, under which our exports of dairy products have since increased with such remarkable strides. Mr. Lynch could have had the appointment of dairy commissioner, but it is in keeping with his character that he declined to reap to his own personal advantage where he had sown so generously. When it is known that he also declined a like appointment offered to him by a foreign government, simply because he did not wish to educate a foreign nation to compete with Canada, and when it is realized that his education of the Canadian farmers has meant millions of dollars in the pockets of the Canadian people, William Henry Lynch may well be enrolled among the Canadian patriots, whose names should pass into history. He was one of the founders of the Canadian Dairyman (the first paper in this country exclusively devoted to dairying), which was afterwards merged into the Rural Canadian. For some years past Mr. Lynch has devoted much attention to mining, being among the first to realize the importance of the developments in British Columbia. He made some suggestions for the improvement of the B.C. mining laws, which, had they been acted on, would have prevented some of the abuses that now exist there.

Mr. Lynch has now been entrusted by the Minister of the Interior with a commission to make a special study of the local condition of the Canadian Yukon district, particularly as to the mining regulations, and to report to Ottawa. Being an original thinker, as well as a man of high ideals, he is not likely to be tied down by precedent, and we may expect that his investigations will result in a code of mining regulations, which while conserving the public interests will give to the honest miner the fullest security, and make the Canadian Yukon a model mining region.

THE CANADIAN MUTUAL AID ASSOCIATION OF MECHANCIAL ENGINEERS OF THE PROVINCE OF QUEBEC.

This association has sent out the following circular to manufacturers: "With a view to securing to manufacturers the advantage of obtaining experienced persons to take charge of steam plants, the mechanical engineers have formed an association which will accept as members only those who are licensed, and firemen who have a thorough knowledge. This association deserves much encouragement because it makes continually a special study of all questions relating to steam machinery, both as to economy and safety. It has also for its aim the mutual aid of its members in case of sickness, and differs from many other societies in that it does not interfere in any way with salaries. Having been founded as much in the interests of the proprietors of steam machinery as of the mechanical engineers themselves, they count on those interested in carrying out these two nobler aims. The president of the association will be most happy to reply to correspondence from engineers and firemen, and will furnish either by letter or personally any information having reference to steam machinery." The circular is signed by Ephrem F. Valiquet, 106 Bourget Street, the president of the association, and is dated from The Mechanical Engineers' Rooms, 392 Lagauchetiere Street, Montreal.

—Bond & Smith, architects, Temple Building, Toronto, are calling for tenders for the reconstruction of a residence on Lowther avenue, Toronto.

—An interesting test has just been completed by James Lang at the power house of the Toronto Railway Co with a view to getting at the actual results of a mechanical stoker as compared with hand firing. The test was made on an improved Jones underfeed mechanical stoker for three days, resulting in a saving of fuel of 15.2 per cent., or an increased evaporation for equal fuel of 17.93 per cent. Minute details of the test are being printed by the General Engineering Co. of Ontario, Canada Life building, Toronto, who will forward the report to those interested in the subject.

"STERLING" HACK SAWS.

Sterling.

Every good mechanic is interested in learning of any new line that will prove to be a labor saver in his work, and the "Sterling" Hack Saw Blade, which has acquired great popularity in the United States is now being freely sold throughout Canada, and used in a large number of the best machine shops. The cost of these blades is less than the value of time spent in filing the old-fashioned blades, which were not tempered. The teeth of these saws are made with a file temper so as to cut through the hardest tool steel, and can be bought at a price so low that it does not pay to waste time in filing saws as had to be done before the tempering of hack saws was reduced to a science, as it now is. The efficiency of these saws is shown by the following tests:

I hereby certify that I was present at a test of the "Sterling" hack saw blade in a 12-inch power saw; that it made 28 clean, even cuts off a bar of Jessop's tool steel; in addition it cut 1 piece 6 in.x5-16 in. machinery steel; 1 piece 3¼ in.x5-16 in. machinery steel; 1 piece 2 in.x5-16 in. machinery steel. Having tried every hack saw blade on the market, I consider the "Sterling" hack saw superior to any blade I ever used.

J. F. Chamberlain,
Superintendent Burgess Arms Co.

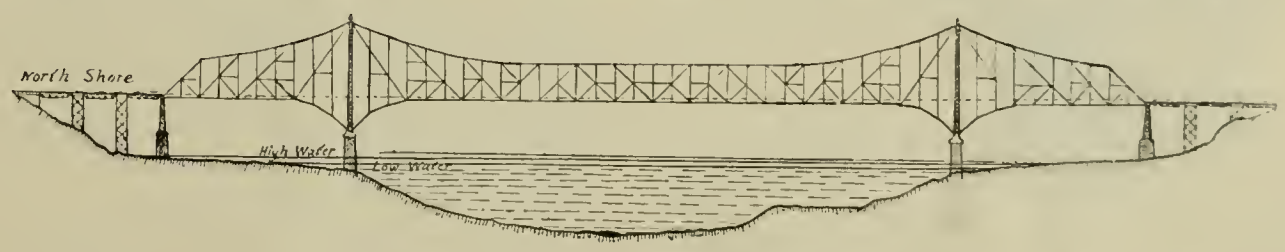
Buffalo, N. Y., March 21st. 1898.

I was present at the Burgess Arms Co.'s plant when the "Sterling" hack saws were being tested in their 12-inch power machine. The test was very satisfactory, cutting 28 to 30 cuts through 1 inch square Jessop's unannealed tool steel; also cutting 1½ in.x5-16 in. machinery steel without breaking. Another saw I used cut through 1 bar 2-inch round, 1 bar 1¼ in.x4 in., 1 bar 2x3 in., 1 bar 3½ in. round, half through, all being unannealed tool steel, saw still unbroken. I consider the "Sterling" equal to any saw in the market. Truly yours,

C. H. Choate,
Tool Maker, Burgess Arms Co.

Buffalo, N. Y., March 21st, 1898.

THE PROPOSED QUEBEC BRIDGE.



Distance between base lines, 2,546.07 feet, from centre to centre of piers, 1,600 feet; between back walls, 3,300 feet; clearance for navigation, 150 feet above high water mark. E. A. Hoar, C. E., is the engineer in charge. Tenders will be called for till Sept. 1st.

FIRES OF THE MONTH.

July 2nd. The Ashbourne flour mill near Bullock's Corners, Wentworth county, Ont.; loss, $10,000; insurance, $8,000.——July 7th. Saw mill owned by Biecher Tingley, Moncton, N.B. ——July 8th. The Mastigouche Lumber Co.'s mills, St. Gabriel de Brandon, Que.; loss, $20,000; insurance, $9,000.——July 10th. Saw mill owned by Daniel Richards, Campbelltown, N. B.; loss, $20,000; insurance about $10,000.——July 11th. The Berlin Brush Co.; partially insured.——July 12th. C. Smith's foundry, Durham, Ont.; loss, $2,500; insurance, $800.——July 13th. The Maritime Sulphite Fibre Co.'s barking mill, Chatham, N. B.; loss, $1,000.——July 15th. The Sherbrooke Iron Works; slightly damaged.——July 17th. The Tilbury, Ont., electric light plant. ——July 20th. N. Cayonette's saw mill, Ste. Moise, Que.; total loss; G. Ross and his son, watchmen, were found burned to death.——July 22nd. The Macdonald Tinware Co.'s factory, Montreal; damages, $15,000.——July 26th. Steamer "D. L. Mather," owned by the Keewatin Lumber Co., burned at Winnipeg; loss, $8,000.—— July 27th. The Linotype Machine Co.'s works, Montreal; loss, $70,000, fully insured.——July 30th. Adam Haines' furniture factory and saw mill, Waterville, Que.; loss about $10,000.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The ninth annual convention of the Canadian Association of Stationary Engineers will be held in Hamilton, Ont., Aug. 8th. The convention will open on Aug. 8th at 11 o'clock, when the Mayor of Hamilton will welcome the delegates to the city. Committees will be appointed and the convention will then adjourn till 10 o'clock on the 9th, when a business session will be held, followed by an aquatic excursion in the afternoon. In the evening E. G. Barrow, C.E., city engineer of Hamilton, will read a paper on "Sewage Disposal," and J. S. Williams, analyst for J. Winer & Co., will read a paper on "Oils in the Engine Room." On Wednesday, Aug. 10th, business sessions will be held. In the evening the annual banquet will be held at the Waldorf.

GORDON J. HENDERSON.

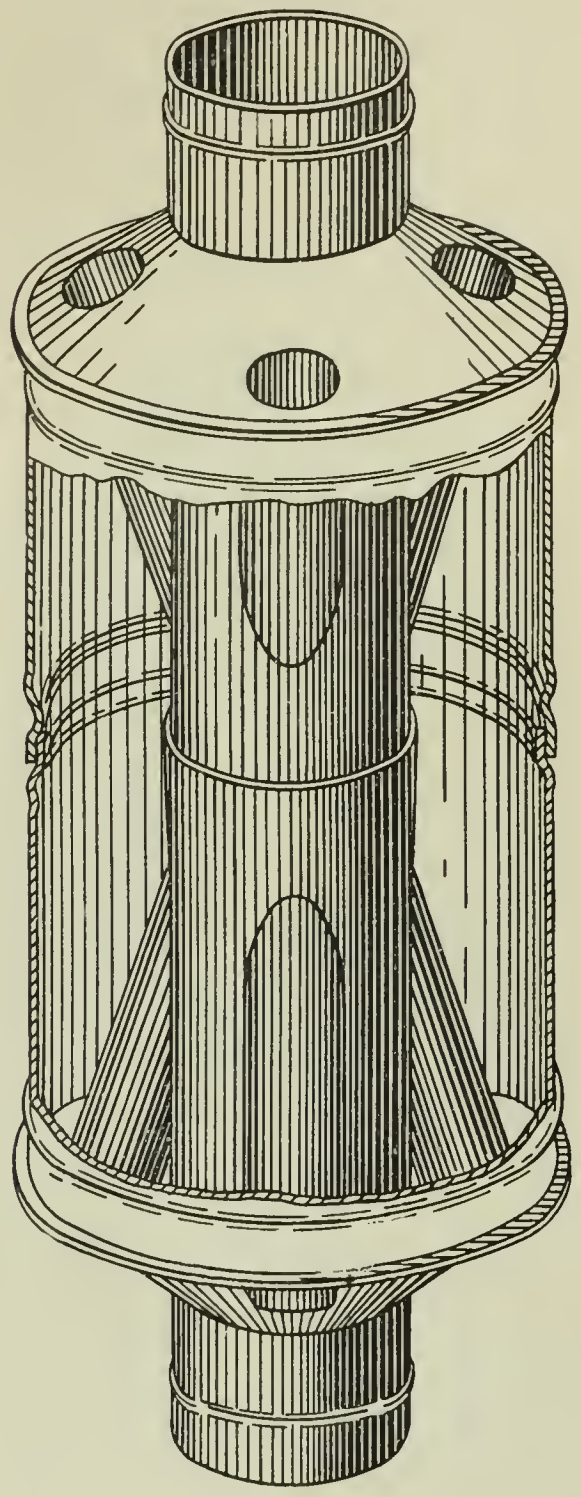
The manager of the Hamilton Electric Light and Power Co., ltd., Gordon J. Henderson, was born in Montreal in 1871, being the son of David H. Henderson, a well-known lumber and timber merchant of that place. Mr. Henderson was six years with his brother, C. W. Henderson, electrical contractor and general supplies, and has been connected with the present company for two years. He has been fortunate in putting this company on a paying basis, as it is a well-known fact that for six years previous to his being appointed manager, it had never paid any dividends. The revenue both from power and incandescent has very materially increased, and expenses all through show a marked decrease. We hope Mr. Henderson will long continue his present successful work. At the recent convention of the Canadian Electrical Association, Montreal, Mr. Henderson was elected a member of the Executive Committee.

THE CHILCOOT HOT AIR HEATING DRUM.

By W. M. Watson.

The coal used in many sections of the country must be imported, which drains the country of its wealth and advances the price of fuel to such an amount that it is necessary to adopt any appliance that will extract an extra amount of heat from the fuel. The majority of hot air furnaces, heating and cooking stoves allow one to two-thirds of the heat from the fire to escape up the chimney unused. The inventor of the Chilcoot Hot Air Heating Drum has clearly shown how much of the formerly wasted heat can now be utilized and made to cause a healthy circulation of warm air in rooms that otherwise would be obliged to have either a hot air pipe or an extra stove to make them comfortable.

Single and double smoke drums have been long in general use and have radiated into rooms quantities of heat in proportion to the exposed surface of the smoke drum, to the distance the drum was placed away from the fire, also the temperature of the fire and the strength of the air draft passing through the fire. It must be borne in mind a coal fire allows its heat to be extracted from it by the iron and brick work that



surrounds the fire, while a fire made of wood is inclined to travel a long way beyond the seat of the fire if allowed to do so, and the smoke drums and pipes of a wood fire will radiate a large share of the heat made in the stove. But no coal fire can burn or be kept alive without some draught of air passing through it which causes the part of the heat of the fire to pass up through the smoke pipes to be discharged into the outside air, unless arrested and radiated into the living rooms by a smoke drum.

It is found that it takes about five times the quantity of heat to raise a volume of water or air ten degrees in temperature more than it does to raise it five degrees, and the difficulty of heating air or water becomes more as the temperature increases. By passing a thin stream of cold water or air over a hot plate at a reasonable rate, about twenty times the number of cubic feet would be heated to a given temperature in a stated time than if the whole quantity of water or air to be heated was collected into one large vessel, and a furnace placed in the centre or under it. Heating the water or air in a thin stream is called heating by circulation. Heating by bulk is called heating by radiation. The fuel that will heat to a temperature of 60 degrees will have to be increased in far greater proportions to raise the heat of the same rooms to 70 degrees. This shows the necessity of using the Chilcoot Hot Air Heating Drum, which combines the two systems of heating in one article. The outside casing or shell radiates quite as much heat as any of the drums formerly used. Then the air of the room is kept in a lively and healthy motion by rapidly passing through an inner drum connected by three collecting and distributing tubes acting similarly to tubes in hot air furnaces. The Chilcoot Hot Air Heater is really a secondary furnace.

The patent rights of this valuable article are for sale by S. J. Robertson, 62 Church Street, Toronto.

LITERARY NOTES.

A very interesting and attractive booklet, "Montreal Homes, Hints to Intending Builders," has been sent us by the author, Arthur J. Cooke, architect, Montreal. It contains a number of illustrations and many suggestions of great value to the intending house owner.

The annual reports of the several departments of the civic government of Halifax, N.S., for 1896-7 have reached us from the office of the city engineer, F. W. W. Doan. A great mass of information, much of it minute in detail, is given. The work of the year in all the departments of the city government is described. The city engineer thus sums up the difficulties of city improvement: "There is a great difference in foremen and the number who can be relied on for cheap work is limited. We are expected to employ men, simply because they are citizens of Halifax, whom no city contractor would have on his work. Such a system is useless and extravagant, if the taxpayer is to get one hundred cents for every dollar expended. The very men that claim that such men are not employed are the first to complain that there is nothing to show for the expenditure. The Works Department is not a Charity Board, and must be run on business principles. Good men can be obtained in Halifax and we should be permitted to select the best. The results during the last three years show what can be done by good men, and the standard set up should be maintained. The accounts of the Clerk of Works tell the story more forcibly than it can be expressed here."

Very few who are engaged actively in the mineral industry are able to find time to read up extensively in technical literature, however much they realize the importance of being fully and accurately informed on all that is going on about them in their own branch of industry. Such busy people will eagerly welcome "The Mineral Industry," each year as it appears from the press, for they find in it a maximum of the information that they need, at a minimum of expense both of money and time. An outline of the table of contents shows the broad field covered by volume VI. This volume contains a review of the production of abrasive materials and their uses, including carborundum, corundum, crushed steel, diatomaceous earth, emery, garnet, grindstones, pumice, quartz crystal, tripoli and whetstones. Special articles on Carborundum, by E. G. Acheson; The Garnet Industry of the United States, by F. C. Hooper, and the Volcanic Ash Deposits of Nebraska, by Erwin H. Barbour. The Mineral Industry, published by the Scientific Publishing Co., 253 Broadway, New York; price, $5.

The "Engineer's Hand Book," just published under the auspices of the Canadian Association of Stationary Engineers, is a handy pocket volume of 286 pages, and contains about 130 pages of tables and information for every day use by steam users, engineers and firemen. Besides a vast amount of data for engineers it contains a short history of the association and its aims. J. G. Robertson, the Executive secretary, assisted by J. J. York, O. E. Granberg, B. A. York and R. A. Ross, E.E., are named as the principal compilers, and well they have done their work It would be hard to find a book in which so much information is packed into so small a compass.

"Friction and Lubrication" is a pamphlet published by the Joseph Dixon Crucible Co., Jersey City, U. S., which describes the excellencies claimed for the preparations of graphite placed on the market by this company. There is also issued by the same company "Graphite as a Lubricant," which treats more extensively of the same subject.

The Ingersoll-Sergeant Drill Co. has issued a new catalogue, No. 32, which illustrates and describes the air compressors built by this company. Separate pamphlets are also issued to describe special installations. One of these describes the plant of the contractor of the Jerome Park Reservoir, New York, who has adopted a compressed air system. The work of excavation involves the removal of over 7,000,000 cubic yards of material, about half of which is rock. The field of operations covers an area of 1½ miles by ¾ of a mile. A compressed

air plant is located at a central point and pipe lines are laid to the points where the work is to be done. At these points are located hoists, pumps, drills and other conveniences for the work, all of which is described in a pamphlet sent out by the company. The Jas. Cooper Mfg. Co., ltd., Montreal, builds this machinery in Canada and Newfoundland.

We have received a very instructive book on "Water and Water Supplies," by John C. Thresh, D. Sc. (London), M.D. (Victoria), Ph. D. (Cambridge), Medical Health Officer to the Essex County Council, Lecturer on Public Health, King's College, London; Editor of the Journal of State Medicine, Hon. Sec. Incorporated Society of Medical Officers of Health, Fellow of the Institute of Chemistry, member of the Society of Public Analysts, etc., etc. The book contains 438 pages, besides a number of illustrations of machinery and appliances, which are of great value. It fully explains and carefully describes the properties and composition of waters, rain and rain water, surface water, subsoil water, natural spring water, deep well water, river water, quality of drinking water, etc. Impure water and its effect upon the health is discussed and the interpretation of water analysis and the pollution of drinking water. The self purification of rivers, the purification of water on a large scale, domestic purification and the softening of hard water are taken up. The quantity of water required for domestic and other purposes, how to select the source of supply wells and how to construct them, pumps of the best kind and pumping machinery, the storage of water, the distribution of water, the law relating to water supplies in Great Britain, are among the other subjects discussed, together with a vast amount of important information necessary for engineers and persons interested in towns or domestic water supplies.

Industrial Notes.

A new public hall will shortly be erected at Millerton, N.B.

The St. Vincent de Paul hospital at Brockville, Ont., will cost $4,000.

The Bushnell Oil Co., Sarnia, Ont., has bought the receiving tanks at Bothwell.

A new hotel to take the place of the burned Clifton House, Niagara Falls, Ont., will probably be erected at a cost of $500,000.

Jno. McGuirl, who was burnt out at Moosomin, Assa., with heavy loss some time ago, will rebuild his wood working factory.

The masons are making good progress with the new buildings of the Deseronto, Ont., Iron Company, and the walls are steadily rising. The carpenters are also at work.

The contract for alterations and additions to the Brantford, Ont., Box Company's works has been let to P. H. Secord. The work is to be completed by 15th September.

The Rathbun Company, Deseronto, Ont., has cleared the ground of the debris caused by the burning of their terra cotta works, preparatory to the erection of new buildings.

D. F. Maxwell, C.E., has been ordered by the St. John City Council to prepare plans for the proposed wharf extension, which are to be filed with the Dominion Government.

The Hamilton Bridge Works, Hamilton, Ont., is very busy and intends to increase its staff. It recently advertised on one day for a stationary engineer, two blacksmiths, four machinists, two punchers and two air riveters.

A. Kellar, Detroit, Mich., wants a free site and a loan of $5,000, in consideration of which he will move the business of the Michigan Heater Co., of Detroit, to Winnipeg. The company is engaged in the manufacture of stoves and furnaces.

J. H. Connor & Son have just completed a new washing machine factory in Jane street, Ottawa. It is three stories high and is operated by two electric motors. The productions of the new factory will be washers and wringers. The damage reported in the firm's late fire was greatly exaggerated, the actual loss being only about $600.

The contract between F. Thompson & Company and Lennoxville, Que., for the building of a system of waterworks for the village of Lennoxville, was signed July 27th, and work was commenced upon the undertaking the next day.

Thos. H. Murphy has purchased from the St. Clair Tunnel Co. all the air locks, rams and fittings used in the construction of the tunnel under the St. Clair. The plant will be used in the contract for the construction of the drainage tunnel in Chicago.

B. D. Hanna, of the Dauphin Railway, has secured some samples of red oxide which were found by a Dauphin man about twenty miles south of Birch Island, in Lake Winnipegosis, Manitoba. If the quality is good the deposits will be of immense value, as there are great quantities of it.

The Shawinigan Water and Power Co. is offering special inducements to manufacturers to locate on the St. Maurice River, Que. Large limits of power may be secured, as this is one of the largest powers in Canada. Information may be had from the company, 1724 Notre Dame Street, Montreal.

Engineer Hibbard, who took soundings for a new bridge at Arnprior, Ont., has sent a report to the town council recommending a two-span bridge with one pier, along with the usual abutments. The cost is estimated to be in the neighborhood of $10,000.

A. Rosseau & Co., Montreal, have been awarded the contract by the city of Quebec for the bridge to replace Bickell's bridge, together with the dam, for the sum of $23.000. The dam or lock is intended to keep the water at a uniform height of twelve feet at low tide around the Victoria Park.

The necessary stock has been subscribed for the proposed scissors factory in Brantford, Ont., occupying a portion of the old Waterous building. The provisional directors are: J. F. Watt, W. R. Turnbull, R. W. Robertson, George Heyd and W. F. Cockshutt.

The annual report of the city engineer of Halifax, N.S., shows that the city water mains have been carefully cleaned during the year, the Kennedy-Keating scraper being used. The engineer also comments on the fact that no progress has been made in the proposed garbage disposal works during the year.

Rhodes, Curry Co., Amherst, N. S., have been awarded the contract for building the Intercolonial Railway pier and sheds in Halifax. The pier will be 600 feet long by 160 feet wide. The plans are completed for the elevator and Hon. W. S. Fielding is said to have promised that the elevator will be open by Dec. 1st.

The committee considering the sewage question in London, Ont., has reported to the city council in favor of the system of the International Sewage Purification Company, Detroit. The plant is to cost $41,300 and the annual expense of operations to be $2,800. Willis Chipman, C.E., is to make a report on the proposed plant.

Mrs. E. J. Sanford, Knoxville, Tennessee, daughter-in-law of Hon. W. E. Sanford, Hamilton, Ont., has given C. Mills, architect, Hamilton, instructions to prepare plans and specifications of a memorial cottage to be erected on the grounds of the Consumptive Sanitarium Association at Gravenhurst, Muskoka.

A license to manufacture in Canada has been granted to the Galena Oil Co., Toronto.

The new iron tank erected by the Edwardsburg, Ont., Starch Co., is nearing completion. It is to contain the water supply of the village, and is forty feet in height, and holds something like 90,000 gallons of water, standing on four legs which are strongly braced. These are sixty-five feet in height, a total height of 105 feet. Two filters are now being installed by the Caledonia Iron Works, Montreal.

The Department of Trade and Commerce has issued a circular calling the attention of manufacturers and others in Canada to the industrial and arts exhibition to be held at Grahamstown, South Africa, from 15th December this year to the 21st January next. Parties wishing to exhibit are asked to make application for space as early as possible, and are notified that arrangements will probably be made for the free transportation of goods to Cape Town. In all likelihood the Government will despatch a vessel direct from Canada to the Cape for the transportation of exhibits, if sufficient are forthcoming to guarantee a full cargo. Parliament, last session, voted an appropriation of $5,000, which can be devoted to this purpose.

Wray & Hawkshaw, Lucan, Ont., have decided to rebuild their flour mill recently destroyed by fire.

The Davis Dry Dock Co., Kingston, Ont., has supplied a compound engine to F. W. Fearman, Hamilton, Ont.

The contract for heating and ventilating the new St. Thomas schools has been given to the Pease Furnace Co., of Toronto.

The Pennsylvania Sanitation Co., Philadelphia, has offered to install a sewerage treatment system in London, Ont., which would treat one million gallons daily at a cost of $1,000 per annum. The bacteria method of purification would be employed.

Dr. Bryce, Toronto, secretary of the Ontario Board of Health, spoke to the town council on a system of sewage for Galt, Ont., recently. Dr. Bryce's address was of considerable length and he urged the people of Galt very strongly to establish a sewage farm at once.

A boiler in Chas. Betts' stave mill, Sycamore (near Coatsworth), Ont., exploded July 15th, instantly killing Jas. Pain, a mill hand, John Rambo, fireman, and fatally injuring Chas. Betts, owner of the mill. The Ontario Government has ordered an investigation to be held.

E. J. Rainboth, C. E., E. S. Leetham, R. G. Code, Ottawa; G. C. Rainboth, Aylmer, Ont.; A. J. Rainboth, Hull, Que., have been incorporated as the Ottawa Suburban Waterworks Company, Limited, to supply gas and water to the villages of Hintonborough and Ottawa East. The capital of the company is $10,000.

On July 12th the Bushnell Oil Co., Ltd., Sarnia, Ont., bought the Petrolia Oil Co., Ltd., Petrolia, Ont., for $4,000, and the Petrolia Crude Oil and Tanking Co., for $17,000, and on the 14th the same company bought the Petrolia Oil Co., Ltd., Sarnia, Ont., for $4,000, and the works of J. R. Minhinnick, London, Ont., for $4,000.

W. H. Croker has completed plans for a large addition to the Tudhope Carriage Company's Works, Orillia, Ont. It will be a four-story building, 50x120 feet. The new building will be used for a warehouse, and will have a floor space of 6,400 square feet, an addition 24x100 feet is also to be made to the wood-working department.

The following contracts have been entered into for the Charlottetown, P. E. I., sewage works: Vitrified pipe, Dodd & Rogers; hard stone, George Battye, Wallace, N. S.; grey stone, John F. Robertson; Portland cement, Dodd & Rogers; brick, Carvel Bros.; pumping engine, the Geo. F. Blake Mfg. Co.; boiler, etc., T. A. McLean.

The new steel bridge over the west branch of the Winnipeg river, Rat Portage, Ont., is now completed, except the approaches, which are to be of earth filling. The construction has been in the hands of T. Jevons, of the Peterborough Bridge Co. It is one of the largest highway bridges in Ontario, the main span being 222 feet in length.

The following tenders were received by the town of Listowell, Ont., for putting in waterworks plant: Clark & Connelly, Toronto, $13,647; McQuillan & Co., Montreal, $14,225; Hill & Gowanlock, $14,899; J. H. McNight, Toronto, $15,173; S. H. Craig, $16,800; J. M. Wallace (piping and trenching only), $6,795. Clark & Connelly were awarded the contract. The firm is installing a waterworks system in Mount Forest, Ont.

The 1898 catalogue of the Sun Bicycle Works shows that the proprietors, G. T. Pendrith & Co., 81 Adelaide street west, Toronto, are steadily gaining popularity with their wheels. "The Sun" wheel and the "Lakeside" are the two special makes of this firm. The latter for a cheap wheel is excellent value, and a Montreal purchaser of one of them informed the writer that her wheel, which cost $55, would pass for an $85 wheel anywhere.

At a special meeting of the Lachine Council, held July 13th, a by-law was adopted granting a bonus of $15,000 to Geo. Barrington & Sons, trunk manufacturers, Montreal, for which the firm will establish their factories in Lachine, Que. The conditions under which the bonus is granted include that the buildings and machinery to be erected to have a value of not less than $25,000, the erection of two factories, the permanent employment of 80 hands, the payment of $25,000 annually in salaries, proper insurance against fire, etc. The bonus will be paid when the factories are in full operation.

The rebuilding of the Truro, N. S., condensed milk and canning factory is progressing rapidly. The new buildings are to be roofed entirely with iron and the contract has been let to an Eastern firm. Roofs of this class are rather uncommon in Nova Scotia.

Incorporation has been applied for by the London Cold Storage and Warehousing Company, Limited, to build and operate a storage warehouse and ice factory in London, Ont. The incorporators are T. H. Smaliman, John Labatt, M. D. Fraser, etc., all of London, Ont. The proposed capital is $75,000.

Railway Matters.

The G. T. R. will construct 250 refrigerator cars for the general service of the system.

A. H. Harris has resigned the position he occupied on the Intercolonial system of railways as traffic manager, and the office itself has been abolished.

Hawkesbury, Ont., has voted a bonus of $7,500 to the Canada Atlantic Railway, to build a siding to accommodate the proposed Riordon pulp mills in that town.

The C. P. R. has under consideration the construction of a branch line of the road to Brantford, Ont. Woodstock being the point at which the connection with the main line will be made.

Neil Keith, railway contractor, is building the C. P. R. branch from Killarney to Hartney, Manitoba. It is understood that Mr. Keith will also build a branch line from Reston to Moose Mountain.

The surveying of a route for the proposed railroad from Amherst, N. S., to the North Shore via Truemanville and Chapman settlement, has been decided upon by the Amherst and Eastern Railway Co.

The Master-in-Ordinary at Osgoode Hall, Toronto, has accepted the tender of Geo. M. Neelon, St. Catherines, Ont., for the purchase of the St. Catherines & Niagara Central Railroad. The bid was $35,000.

The Grand Trunk Railway is renewing the bridges between Island Pond and Montreal. The iron bridge over the Magog and the bridges at Massawippi, Lennoxville, Brompton and Richmond are among the number.

The G. T. R. celebrated the semi-centenary of its Portland line, July 4th. During this time the lines have been extended from 292 miles to 4,186 miles. Fifty years ago the passengers carried numbered 686,924, and in 1897 there were over 8,000,000.

O'Brien & McDonald, Renfrew, Ont., railway contractors, have a contract in Nova Scotia, to build a railway across Hants County between Windsor and Truro. The work which O'Brien & McDonald have consists of twenty miles of grading and sixty miles of ballasting and track laying.

The suggestion that railway employees should be subjected to a severe physical examination and course of technical instructions before being allowed to assist in the operating of trains and switch yards, has been made by the Association of Railway Surgeons in session at Toronto. The association elected as president for the ensuing year, Dr. Bruce L. Riordan, the G. T. R. surgeon at Toronto.

The contract between the city of Quebec and the Great Northern Railway Company has been signed by Mayor Parent and the Hon. P. Garneau, president of the railway company. By this agreement the city invests $200,000 in the stock of the Great Northern and the latter is to give Quebec railway connection with the Booth system, thus making Quebec an exporting port for the Parry Sound traffic.

H. D. Lumsden, C. E., of the Canadian Pacific Railway, who has been engaged at the head of several surveying parties, whose object was to secure a good route for the railway that company contemplates building from a point north of Toronto to Sudbury, Ont., states that a first-class line has been secured, and one where few engineering difficulties are met with. It is pretty well understood that the C. P. R. will enter upon the construction of the road without delay.

The Canadian Pacific will probably extend its Point Fortune branch of the Montreal and Ottawa to Hawkesbury, Ont.

A building 50 feet wide by 100 feet long will shortly be built on the G. T. R. car shops property, London, Ont. It will be for the stores department, and will cost about $5,000 or $6,000.

The Pullman Car Company has completed twenty first-class cars for the Grand Trunk, an order which represents over $100,000. The cars are all of the latest design, and will be a great addition to the Grand Trunk's rolling stock.

The Ontario Public Works Department has received information that the Pembroke Southern Railway, running from Pembroke to Golden Lake, on the Ottawa, Arnprior & Parry Sound Railway, a distance of about 20 miles, will soon be completed. The new line, which crosses the townships of Pembroke, Alice, and Wilberforce, and, after spanning the Bonnecheres river, connects with the O. A. and P. S. Railway, in the township of South Algoma, will, when completed, give Pembroke a competing line with the C. P. R., and will open up a very fair agricultural country. The railway is being constructed by Contractor Poulin, formerly chief engineer for the Parry Sound Colonization Railway.

W. D. Reid, son of R. G. Reid, the Newfoundland railway contractor, when in Montreal recently, stated that they had run a train through from St. John's to Port aux Basque, the terminus on the west coast, in twenty-four hours, the distance being 550 miles. The trial trip was made, however, under most favorable auspices, and the whole distance from east to west was run on schedule time. It is Mr. Reid's intention to establish hotels at different points on the system, so that when the expected influx of tourists, business people and sportsmen sets in, they may be comfortably provided for at whatever section of country they see fit to visit. At present Mr. Reid's steamer, the Bruce, makes two trips a week between Placentia and North Sydney, but with the railway to Port aux Basque the boat will run to that port three times a week, the distance across being made in six hours, and giving Newfoundland a tri-weekly mail to and from the Dominion of Canada. The establishing of separate steamship lines connecting the settlements along Placentia, Trinity and other bays, on south, east and west coasts, with his railway system, is also another important feature in Mr. Reid's vast enterprise in Newfoundland. Plans for seven of these steamers are now being prepared, six for the trade just mentioned, while the other is intended for the Labrador traffic. These vessels will be about 250 tons register, and besides being good freight carriers, will possess superior accommodation for about twenty first-class and from fifty to sixty second-class passengers. They are to be built on the other side of the Atlantic, and while some of them will be placed on their respective routes next spring, the remainder will commence the service a year later.

Marine News.

The steamer "D. L. Mather" was burned to the water's edge at Rat Portage, July 26th. It was insured for $8,000.

The Standard Oil Co. is negotiating with the Canadian Locomotive and Engine Works Co., Kingston, Ont., for the building of a number of steel tank barges to carry oil from the refineries to the distributing points.

The launch of the Dominion Atlantic Railway Company's steamer "Prince Arthur" took place at Hull, England, July 19th. W. R. Campbell, the general manager of the company, was present.

The Richelieu & Ontario Navigation Company will, it is understood, have another boat built at the Bertram yards as soon as the "Toronto" is launched. It will be called the "Kingston," and will be constructed on the same model as the "Toronto," and will cost $250,000.

Lieut. Porter, of the U. S. Cruiser "Yale," has been appointed to command the Rita when she is turned into a transport. He was the officer who commanded the prize crew when she was first captured. Mr. Porter is a son of the Rev. W. H. Porter, Brantford, Ont.

Petersen, Tait & Co. have been notified by the Canadian Government that the fast mail contract must be considered at an end. Petersen's firm will forfeit its deposit of £10,000.

An Ontario charter has been granted to W. J. Brown, Mrs. A. A. Brown, and John McLean, manufacturer, Detroit, U.S.; and T. Mulvey, and J. L. Galloway, Toronto, Ont., as the Georgian Bay Navigation Company, limited, with a capital of $20,000.

T. Eaton's steam yacht the "Wanda" was built from the designs by E. Redway, marine engineer for the Polson Iron Works, Toronto. The dimensions are: Length over all, 55 feet; beam, 3 feet 2 inches; draught, 3 feet 8 inches; displacement, 9 tons; triple expansion engines, 5½, 8½, and 14 inches, with 8 inch stroke; boiler, improved Yarrow carrying 200 lbs. pressure: indicated horse-power, 100; estimated speed, 16 miles per hour. The yacht cost $6,000.

Canadian Pacific Navigation Company are arranging for the building of a fast steamer for the route between Victoria and Vancouver, to give a daylight service. The plans are out, but at present the shipbuilding firms of England and Scotland have too much work on hand to undertake the contract, so it may be a considerable time before the work is begun. The new vessel will, it is said, be much larger than the "Charmer," and faster than any steamer now in service on the Pacific coast.

Last fall the United States government put surveyors on the route of the proposed Michigan-Erie canal, and the chief of the party has just made his report, and he says the canal would not be a difficult work to construct. The line would be from Benlow harbor on Lake Michigan to the Maumie River at Toledo. That would reduce the distance from Chicago to Toledo to 101 miles, a saving of over 900 miles over the present route from Chicago to the mouth of the Detroit River by way of Lake Michigan, Straits of Mackinac and Lakes Huron and St. Clair, and a canal to pass vessels of the heaviest tonnage of the lakes would cost about $40,000,000.

As soon as the proposed Montreal harbor improvements are commenced the Richelieu & Ontario Navigation Company's boats will have to take up new quarters. General Manager Gildersleeve has already made the necessary arrangements. The Quebec steamers are to lie where the "Laprairie" berths now, at the front slip below Jacques Cartier wharf, while the "Laprairie," "Cultivateur," "Three Rivers," "Terrebonne," "Berthier," and "Chambly" will rendezvous at the Victoria pier, or in adjacent slips. New sheds will have to be erected for freight.

Electric Flashes.

Street railway construction is being rushed in St. John's, Nfld., under Engineer Massey.

Galt, Ontario, will shortly vote on a by-law to provide for taking over the town's gas and electric lighing plant.

The Napance Electric Light & Water Co. has ordered from the Royal Electric Co. a 35-k.w. two-phase generator and 500 light capacity in transformers.

The by-law to raise $19,500 for waterworks and electric light purposes in Listowell, Ont., was defeated, July 6th, by a majority of 71 votes, on a total vote of 427.

English capitalists have secured a controlling interest in the New Westminster and Burrard Inlet Telephone Company. The lines of this company extend over a considerable area.

The proposed Lanark-Perth electric railway is being revived. The subscribed capital is now said to be sufficient to build the road, and the company undertakes to complete it by April 1st next.

The town of Thorold, Ont., will receive tenders to Aug. 17th for an incandescent lighting plant of 1,500—2,000 lights, alternating current, according to specifications prepared by R. J. Parke, consulting engineer.

The desire for cheaper telephone service has induced the organization of a company in London, Ont., to rival the Bell Co., and give a house service at $18 and office for $25. Several strong local capitalists are interested, including Col. Leys, John Labatt and John Milne.

The Electric Street Railway, Cornwall, Ont., is building a deep water wharf at St. Lawrence Park.

The Jenckes Machine Co., Sherbrooke, Que., has the contract for installing the lighting plant at Granby, Que.

David Spiers, Galt, Ont., has bought a water power, and may install a power plant if satisfactory arrangements can be made.

The Ottawa Electric Railway is putting its employees on a ten-hour day instead of the eleven hours which had caused some friction.

The West Kootenay Power and Light Co. is now delivering 1,000 h.p. in Rossland, B. C., from its generators at Bonnington Falls, B. C., 30 miles away.

Mrs. Wm. S. Dockrill, Montreal, has ceased to do business alone under the name of W. S. Dockrill & Co., and has formed a partnership under the same name, as electrical engineers with Ernest W. Sayer.

McCurdy & Co., of Antigonish, N. S., are enlarging their electrical plant and have a contract to light the streets of the town. A 60-h.p. engine and boiler have been ordered from the Robb Engineering Co., Amherst, N. S.

McCurdy & Co., Antigonish, N. S., are enlarging their electric light plant and have a contract to light the streets of the town. A 60-h.p. engine and boiler has been ordered from the Robb Engineering Company, Amherst, N. S.

At a meeting of the special committee of the Hamilton city council, on civic electric lighting, it was decided to recommend the council to engage Roderick J. Parke, Montreal, consulting electrical engineer, to report on the cost of establishing and operating a civic electric light plant. The council, however, overruled the committee and engaged Percy Domville.

The Niagara Falls Park & River Railway Co., are now running cars every five minutes over the upper steel arch bridge. The first car was run over, July 1st, with Supt. Rothery at the motor. Manager Phillips of the N. F. P. & R. R., and Supt. Dill, of the new bridge, were on board.

The Crow's Nest Pass Coal Company, ltd., Fernie, B. C., has placed an order with the Royal Electric Co. for 2 25-k.w. direct current generators wound for 250 volts, from which is to be operated a trolley-car equipment for drawing coke to the smelters and also mining, hoisting and lighting apparatus.

The London, Ont., Electric Co. is now installing two 160-k.w. direct current power generators, and a 300 k.w. alternator of the revolving field type, from the Canadian General Electric Co. The power generators will be operated by two engines of 250-h.p. each, made by E. Leonard & Sons, of London.

Edward Slade, electrical contractor, Quebec, is putting in a dynamo, and the necessary wiring for the electric lighting of Capt. Bolduc's new steel boat the "Orleans," plying between Quebec and Ste. Petronille. Mr. Slade has got the contract for wiring the SS. "Champion," and also the Beaufort Asylum, 600 lights.

C. E. Shedrick, who manufactures in Canada the apparatus of the Whitney Electrical Co., will again occupy a portion of the Sherbrooke, Que., Gas & Water Co.'s building recently destroyed by fire as soon as it is ready for him. The business, which has been rapidly increasing in volume, will not be injured by the fire to any great extent.

R. A. Bayley, sec.-treas. of the People's Telephone Co., of London, Ont., has written to the Mayor of Hamilton, Ont., requesting that that city do not grant a franchise to any parties for a telephone company without communicating with it. This is in connection with the movement to establish local telephone companies in each town in Ontario in opposition to the Bell monopoly.

H. Alabaster, Gatehouse & Co. publishers, 4 Ludgate Hill, London, E. C., announce that the 1899 edition of the "Universal Electrical Directory" is in course of preparation for its 18th annual issue in January next. Manufacturers and others interested would do well to send in their names at once so as to be included in the forthcoming edition. No charge for such insertion is made.

Some Galt, Ont., people have formed a scheme for the construction of an electric road from New Hamburg to Galt through Haysville, New Dundee, Roseville and Blair.

Paris, Ont., wants to secure C. P. R. connection by building an electric line from Paris to Ayr, Ont. The promoters are asking for no bonus, but simply for the right of way through the municipalities, a distance of seven miles.

A scheme is on foot to connect Brantford, Ont., and Port Dover electrically, a new line being built from Port Dover to Waterford, and the T. H. & B. tracks being used from there to Brantford. The proposed line is to be known as the Brantford & Port Dover Railway.

The poles for the Cataract Power Co. are now all up between Hamilton and Decew's Falls. Four heavy copper wires are strung from Hamilton to Stoney Creek, about one-quarter of the total distance, and the balance will be strung at the rate of two miles a day. The insulators are being tested at an average of 600 per day, and are tested up to 70,000 volts.

Ontario charters of incorporation have been granted to the following companies: "The People's Telephone Company, of St. Thomas, ltd.," with a capital of $60,000, and the following projectors, A. E. Wallace, E. A. Smith, F. M. Griffin, S. Chant, W. H. Murch, D. McLarty, T. W. Duncome, J. Campbell and A. McCrimmon, of St. Thomas, and H. C. Walters and R. H. Evans, of Detroit, and also to the "Electric Cloth Cutter Company of Toronto, ltd.," with a capital stock of $40,000.

Notices are being sent out to the creditors of the Hamilton Electric Light & Power Company, asking them to send in their accounts for settlement, in view of the taking over of the company's business by the Cataract Power Company. This is understood to refer to a bargain by which the Cataract Power Company undertakes to supply power for fifteen years, and will share in the expected increased profits, but the Hamilton Electric Light & Power Company will not be absorbed, but will continue in existence. It is said the bargain also permits the Cataract Power Company to supply power to the city if the latter goes into the electric lighting business.

The Canadian General Electric Company is manufacturing an incandescent lamp called a "night lamp." It has a device by which it can be changed from 16 c.p. to 1 c.p. The transformation from 16 to 1, or from 1 to 16 c.p., is effected by turning a small screw on the side of the lamp. The current consumed by the lamp when burning at one candle power is less than half of that which it requires at 16 candle power. In appearance, the night lamp resembles the ordinary 16 candle lamp with its bulb frosted. The peculiar construction of this lamp which gives it its double nature, consists in dividing the carbon filament into two sections, one of which is switched into circuit when 16 candles are desired, and both sections—one in line with the other—when only one candle is desired. The additional resistance causes the filament to give out less light.

Henry Symons, Q.C., has just returned from England, where he had estimates prepared for the construction of the proposed works of the Welland Power & Supply Canal Company. This project involves the construction of a canal from the Welland River to the brow of the Mountain at Thorold, a distance of 8 miles; the construction at Thorold of a power house, and from Thorold to Lake Ontario, a raceway by which to carry water into the lake. In addition to these different works, estimates were obtained for the construction of a transmission line from Thorold to Toronto by way of Burlington Beach. The estimates obtained by Mr. Symons were prepared by Dr. Hopkinson, F.R.S., one of the leading electricians of Great Britain; Sir Douglas Fox, Edmund Wragge, late of Toronto, and W. C. Unwin. The estimate for the machinery to generate 100,000 horse-power is £125,000; for transmission line to Toronto at a voltage of 10,000 and delivery of 50,000 horse-power, £801,600; for excavation and other work connected with the undertaking, £1,525,062. The total estimate therefore amounts to £2,452,162, or roughly speaking, $12,000,000. If the amount to be delivered in Toronto is reduced to 20,000 horse-power, the project would cost $1,000,000 less. S. Pearson & Son, contractors, state that if the contract could be secured from the cities of Toronto and Hamilton for a considerable quantity of power, for a definite term, there would be little difficulty in raising money for the project by bonds and shares in Great Britain.

Mining Matters.

Mica of very fine quality has been discovered near Arkell, Ont.

A steam plant is being installed on the Atlantic Cable mine, Rossland, B.C., owned by William Caldwell, Toronto.

Rich quartz is reported from the township of Dysart, Haliburton, Ont. It is also stated that beds of sand containing gold exist in the same locality.

Efforts are being made to develop natural gas extensively at Humberstone, Ont., with a view of inducing manufacturers to locate in that neighborhood.

The Summer Mining School maintained at Rat Portage, Ont., by the Ontario Government is conducted this year by J. Watson Bain, B.A., Sc., of the School of Practical Science, Toronto.

The War Eagle mine of Rossland has let a contract to the Wellman & Sevver Co., Cleveland, Ohio, for the construction of a large steel gallows, frame and hoisting apparatus, at a cost of $20,000.

The Donnelly Bros., Kingston, Ont., have purchased all the plant of the Frontenac Oil Company at Fredericksburg. The plant consists of steam engine and boiler, 15,000 feet of 8-inch pipe, drill, derrick and tools.

The Kaladar and Anglesea Gold Mining Company will at once begin the erection of a separating plant on its property at Bridgewater, Ont. The work will be performed under the direction of Dr. Eames, the company's assayist.

A company has been formed in Vancouver, Ont., to dredge for gold in the rivers of the Yukon district. A special pneumatic caisson and air-lock elevator will be used, which it is claimed will make the work of dredging to bed rock easy. H. Abbot, R. G. Tatlow, J. W. Campion, S. O. Richards and Major C. C. Bennet, Vancouver, are interested in the company.

The Harris Sulphur and Copper Company, Glasgow, Scotland, has secured options on several copper mines in Newfoundland, which were secured by an expert sent out to examine them. These properties include the Colchester, Robert's Arm and Sunday Cove mines, all situated on North Dame Bay, as well as a lease of the Silver Cliff mine on Placentia Bay.

R. Prefontaine, M.P., J. R. Fair, Montreal; C. A. Chenevert, Berthierville; A. Brosnan, J. U. Gregory, Quebec; C. King, Sherbrooke; L. F. Morrison, Saint Hyacinthe; C. Nelson, Montreal, and W. de F. Nelson, Saint Paul, U.S.A., have secured a Quebec charter as the Eastern Townships Chrome Iron, Mining and Milling Company, Ltd. Capital, $50,000; headquarters, Montreal.

Archibald Blue, Director of the Bureau of Mines, has received a letter from Prof. W. L. Goodwin, Principal of the Kingston School of Mines, stating that the summer mining at Parry Sound had proven a great success. In all 51 students had attended, and the daily average attendance had been 20. The school at Mattawa had been, he said, even more successful. There 72 students had come, and the average attendance had been 45, and there was no indication of a falling off. The bureau has divided their summer school between the School of Science and the Kingston school, the former taking the district west of Michipicoten and the latter Michipicoten and the territory east.

The officers of the Toronto Smelting Company, Limited, Madoc, Ont., are: James Kendry, M.P., Peterboro, president; J. B. Hay, Toronto, 1st vice-president; F. C. Flannery, Toronto, sec.-treas, and W. A. Hungerford, M.E., Belleville, general manager. Two smelters of five and fifteen tons capacity respectively have been put in for the smelting of ore and the manufacture of mineral wool. Mr. Burton of St. Louis, Mo., has charge of the smelters; Mr. Norman, a gold medalist graduate of the school of mines for the State of Missouri, is in charge of the assay department, and George Lee, of Staffordshire, England, superintends the roasting of arsenical ores.

As showing the extent of the work going on in Rossland at present a western contemporary states, when speaking of the recent driving of a tunnel between the Le Roi and the Black Bear mines: "Only a very few feet of work would be necessary to drive a shaft from the Le Roi's workings to those of the Centre Star, and if this is ever done it would give a continuous underground passage from the Black Bear through the Le Roi into the Centre Star, thence into the Iron Mask and from there to the War Eagle, for the workings of the latter mines are already connected. From the War Eagle it would require only a few feet of work to connect with the Poorman, and as the latter already opens into the Josie, it would thus extend the chain of connecting properties through to the latter mine. The horizontal workings thus connected would measure about three miles in length."

The Cumberland Railway and Coal Co has a contract for 50,000 tons of coal for the I.C.R.

The Grand Calumet Mining Co., Calumet, Que., has made a trial shipment of 250 tons of ore to Belgium.

J. E. Hardman, B.Sc., of Montreal, spent some time in the Whycocomagh district of Cape Breton recently, in the interest of Canadian capitalists.

Wallace Bell, well sinker, St Lawrence street, Montreal, has gone to Newfoundland, where he will help in developing the newly discovered oil regions in the island.

F. H. Drew, Michipicoten, Ont., reports the discovery near Lake Wawa of a vein of copper-bearing ore very much like that in the famous Calumet and Hecla mine, Michigan.

Gold is reported from Chelsea, Molega, Lunenburg county, N.S., and prospectors are said to have cut a large and rich looking lead there, which shows gold very plainly in the outcrop.

The Boston Company developing the oil wells of Lake Ainslie, Cape Breton, are progressing favorably with the work. They have lately received 16,000 feet of wall casing which will be utilized in the work.

W. J. Hopgood, Spring Garden Road, Halifax, N.S., has chartered a small schooner which will carry provisions, implements and mining men necessary to prospect for some time on the coast of Labrador, where traces of gold have been reported.

The Ingersoll-Sergeant Drill Co., New York, has just issued a new air compressor catalogue, No. 32, which illustrates and describes the compressors which are making such a name for themselves on the Canadian market, for which they are manufactured by the Jas. Cooper Mfg. Co., Ltd., Montreal.

The old Bruce Mines, near Thessalon, have been taken over by Lord Douglas, of Hawick, on an option, writes an associate of this gentleman, to the Bureau of Mines. For some time past Lord Douglas has had experts at work on the mine, and their reports have been very encouraging.

E. R. Faribault, of the Geological Survey, Ottawa, is at present at work in Nova Scotia. He will survey Renfrew, South Uniacke, and Mount Uniacke. After these districts are covered, he will remove to Halifax and from there go over Cow Bay, Montague, Lake Catcha and possibly Lawrencetown and Tangier.

A deposit of manganese has been located at New Ross, Lunenburg Co., by Charles Keddy and W. Rafuse, on the property of Peter Benjamin of the above place. It is said that several barrels of the outcrop were sent to New York to be tested, and the reports received are said to give ore values of from $15 to $60 per ton.

The Government has refused to prohibit the exportation of natural gas from Ontario, as requested a few weeks ago by the largest deputation that ever visited Ottawa. The people of Essex asked, failing total prohibition, for a heavy export duty. This, too, has been refused. Permission has been given the American concern—the Interior Construction and Improvement Company—to lay two new conduits from the town of Sandwich to Detroit, and to convey across the border up to three billion feet of gas per annum. This is accompanied by some conditions which may not be enforcible. At the end of three years the company which is now reaching out into Ohio, is to confine its operations to Detroit. It is provided that natural gas must at all times be sold in Canada at ten per cent. lower than the lowest price at which it is sold at any other point, and that the selling price in Canada at any well, or on the highway nearest the well, shall not exceed five cents per thousand feet. The company is forbidden to use artificial means for drawing gas from the wells.

From Sault Ste. Marie Prof. A. P. Coleman, of the Provincial Crown Lands Department, writes his chief, Director Blue, of the Bureau of Mines, as follows: "We have just returned from a ten days' trip down the St. Mary's River, and along the north shore of Lake Huron as far as Thessalon. We visited Garden River, Echo Lake, Bruce Mines and Thessalon, making a survey of the shores and pushing a few miles inland at each place. The more important mines along the shore and inland have been visited, with the exception of the placers near Thessalon, where we found no work is at present going on. We hope to see them later in the summer. The most interesting point was, of course, Bruce Mines. We found the Cleveland Company at work with more than forty men at the quarry of 'trap' or diabase, for the boulevards of that city. Mr. Spence, who is managing the operations at the quarry, says that these roads cost at present $2 per square yard, and that the surface, when complete, is far better than asphalt, not having the slippery character of the latter in rainy weather, and being far more durable. This pavement might be introduced into Toronto for good residence streets."

Considerable interest has been aroused in England over the discovery of corundum in the township of Carlow, Hastings county. Ontario corundum, it will be remembered, is a valuable substitute in the manufacture of abrasive wheels, and is also one of the chief bases of aluminium. In an editorial the London (Eng.) Mining Journal discusses at length the discovery of the mineral in Hastings and speaks about its possibilities as a commercial product. The Journal notes the fact that the deposits have been traced through over seven different townships over an area of about 100 square miles, and goes on to give in detail the circumstances surrounding the discovery of the deposits and its exploration by private parties and agents of the Ontario Government. The Journal then proceeds to say that in the United States and in Europe aluminium is produced chiefly from kaolin and cryolite, which contain a smaller percentage of the finished metal than does corundum. The only known valuable cryolite mine is in Greenland, where mining operations are conducted with much difficulty. In Ontario these corundum deposits are easy of access and may be worked continuously all the year round. As an abrasive material this corundum has already been favorably reported upon by American experts who have examined samples. If it turns out, as seems probable, that the corundum can be smelted economically for the production of aluminium this will give it a value second to none in the mineral resources in Ontario. The tests which have so far been made are merely sufficient to show that successful concentration of the ore is feasible on a large scale. The Mining Journal gives prominence to its editorial and seems to consider the possibilities of the Hastings deposits to be good.

Personal.

T. J. Sabin, contractor, Peterboro, Ont., was drowned in Little Lake, Ont., while fishing.

R. Cullen, snperintendent of the sulphite plant in the Riordon Paper Mills, Merritton, Ont., has gone to Hawkesbury, Ont , to superintend the mills to be established there.

Grant Hall, mechanical foreman of the Intercolonial Railway, Moncton, N.B., received notice of dismissal, to take effect on Aug. 31. His place is to be taken by Fred G. Hunter.

Edward Butler, Government electrician for the Lachine Canal, Montreal, died recently after a three weeks' illness. He was forty-two years old, and leaves a widow and eight children to mourn his death.

Mr. Spencer, formerly an engineer in the employ of the Peninsular and Oriental Steamship Co., running between Bombay and Hong Kong, has located in Galt, and is now employed by the Goldie-McCulloch Co.

James Green, a well-known G.T.R. engineer, died at Stratford July 13th, aged forty-four years. About twenty-three years ago he entered the employ of the G.T.R., and had ever been a faithful and attentive employee.

John Patton, foreman pattern maker in the Truro Foundry and Machine Co.'s works, and one of the oldest employees of the company, lost four fingers from his right hand, owing to it coming in contact with a saw a short time ago.

Andrew Harrison, an employee of the Canada Sugar Refinery &o., Montreal, was killed a short time ago by coming in contact with the transmission wires of the Lachine Rapids Hydraulic and Land Co. while holding on to part of an iron bridge.

Henry Szlapka, engineer and manager of the Hamilton Bridge Works Co., Ltd., Hamilton, Ont., was very successful in the discharge of his duties when on the staff of the New Jersey Steel and Iron Co., Trenton, N.J., where he had charge of the designing department.

Joseph Taylor, formerly secretary of the Michigan Peninsula Car Works, and identified for years with some of the most prominent business interests of Detroit, died July 19th at his summer residence, Taylor Point, Sandwich, Ont. Mr. Taylor was 58 years of age, and was born in England, but had spent the greater part of his life in Detroit. He was formerly for ten years chief assistant to the general manager of the Great Western Railroad.

T. B. Speight, of Speight & Van Nostrand, has been commissioned by the Government to run an exploration line due north from the head waters of Goulais River, following the 84th meridian, to the C.P.R. Railway, a distance of 90 miles. This is a district that is almost wholly unknown. Mr. Speight will be accompanied by a woodranger and a geologist, W. A. Charlton, who will explore the country for a distance of ten miles on either side of the line, and report upon the timber and mineral resources and the agricultural possibilities of the district.

Joseph Middlemas, engineer at the Deaf and Dumb Institute, Belleville, Ont., has been relieved of his duties.

Jos. McGregor, Nanaimo, B.C., has been appointed provincial inspector of metallurgical mines for British Columbia.

George Todd died in Fredericton, N.B., on the 12th ult., at the age of 86 years. He was the originator and manager of Todd's foundry , Woodstock, N.B.

J. N. Young, general manager of the Dominion Construction Company, has removed from Hamilton to Chicago, after a residence in the former city of about nine years.

Leopold Meyer, mining engineer, of California, has moved to Ottawa, Ont , with his family, to live. He has been appointed manager of the Grand Calumet mine, Pontiac county, Que.

Thos. McFarlane, lately chief clerk in the office of the superintendent of motive power of the Grand Trunk Railway, Montreal, died in Brockville, Ont., a short time ago, at his father's home.

Wm. Tye, C.E., formerly of Haysville, Ont., has been appointed chief engineer of the Robson and Boundary Creek Railway at $5,000 a year, and a good bonus if he succeeds in getting it finished on time.

D. McLennan, of the Auditor-General's office, has been appointed astronomical computer to W. F. King, chief astronomer of the Department of the Interior. Mr. McLennan is a graduate of Toronto University.

W. J. Weller has been appointed superintendent of bridges and buildings of the Crow's Nest Pass branch of the Canadian Pacific Railway, with headquarters at Lethbridge, Alberta, in place of R. Balfour, resigned.

W. F. Robertson, New York, who has succeeded W. A. Carlyle as British Columbia minerologist, is a graduate of McGill University, and is very highly recommended by Dr. Dawson, head of the Dominion Geological Survey.

Henry Tandy, of Dunkirk, N.Y., has been appointed superintendent of the Canadian Locomotive and Engine Company, Kingston, Ont., in place of F. J. Leigh. Mr. Tandy was previously connected with the works in Kingston, and is a capable manager.

Thomas A. Harvey, formerly with Moore & Henry, London, Ont., who has recently graduated with the degree of civil engineer from the Rennsselaer Polytechnic Institute, Troy, N.Y., has taken a position in the bridge and construction department of the Pennsylvania Steel Company, Harrisburg, Pa.

J. Murphy, engineer for the Cornwall Electric Street Railway, who has taken a good position in Montreal, was presented by the employees of the railway with a beautiful smoking set as a token of their esteem. The present was accompanied by an appropriate address, which was read by Mr. Taylor, superintendent of the company.

Among the Royal Military College graduates who have recently received good appointments are : Capt. A. H. Van Straubenzie, R.E., who has been appointed to the command of the "M" submarine mining company at Chatham. He is a son of Lieut-Colonel Van Straubenzie, late D.O C., Kingston. Lieut. A. Adams, R E., third-class, first grade superior revenue establishment of Burmah State railways traffic department, has been promoted to second class fourth grade of that establishment. He is a son of Mr. Adams, architect, late of the Kingston penitentiary staff. Captain A. C. Joly de Lotbiniere, C.E., has been appointed assistant instructor, School of Military Engineering, Chatham.

We regret to record the death, in Montreal last month, of Thomas Hartnell Spurrier. Mr. Spurrier was born in Shepherd's Bush, London, England, thirty-seven years ago, and was educated at Spurgeon's College and afterwards at Regent's Park College. His parents intended him for the ministry, but Mr. Spurrier preferred literary and artistic work, and was engaged in painting and newspaper work before coming to Canada. He settled in Montreal five years ago and was engaged by McGill Medical College to do the anatomical painting of that institution. He also contributed some spirited cartoons and sketches for the daily press as well as for THE CANADIAN ENGINEER. He was very popular among the engineers, his sketches of the annual conventions having been much appreciated. A few weeks before his death he had finished the compilation of a book on the "Yukon Region of Canada," which is shortly to be published by a London House. Mr. Spurrier was an agreeable companion and conscientious worker and will be mourned by many friends as well as his family. He leaves a wife and three young children. He had just brought his two eldest children through a severe attack of typhoid fever, which he himself took with fatal result as they were recovering.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during June and the six months ending June, 1897, 1898:—

	Month of June.		Six months ending June.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£6,283	£1,675	£31,930	£11,918
Pig iron	1,847	384	2,865	6,157
Bar, etc.	808	1,627	5,013	6,737
Railroad	..	7,845	20,286	14,817
Hoops, sheets, etc.	6,245	5,034	22,690	16,626
Galvanized sheets	3,377	3,187	19,375	24,167
Tin plates	7 981	11,507	88 953	73,475
Cast, wrought, etc., iron	2,369	2,684	17,334	16,342
Old (for re-manufacture)	925	1,571	1,497	3,075
Steel	4,958	3,559	23,438	27,857
Lead	2,806	4,240	7,260	12,290
Tin, unwrought	909	1,698	9,834	10,785
Alkali	3,638	4,273	15,360	21,010
Cement	1,777	1,700	6,555	10,052

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

I think it advisable, in an article of this kind, to state, as premises, certain propositions which might be treated as deductions. Some of them are self-evident, and ought to appeal to any practical mind as being truths, rather illustrated than demonstrated by the experience of the past few years. In accordance with this line of treatment, I desire to state by way of premise:

It may be claimed that no construction is "fire-proof," and that even iron and masonry could with propriety be designated as "slow burning." The iron or steel used in a modern building has, in its time, been smelted in a furnace which presented no greater capacity for running metal into pigs than some of our modern buildings, whose interior openings from cellar to roof correspond to the chimney of a furnace, and the front door to its tuyere. If a pyrometer could be adjusted during the progress of a fire it would be found to rise quite as high as in any forge.

Glass windows will not prevent the entrance of flame or heat from a fire in an exposed building. It may seem strange that so obvious a proposition should be thought worth stating, and yet to-day more than 75 per cent. of the "fire-proof" structures of the country have window openings to the extent of from 30 per cent. to 70 per cent. of the superficial area of each enclosing wall without "fire-proof" shutters. Heat from a building across a wide street finds ready entrance through windows, and the several "fire-proof" floors serve only to hold ignitible merchandise in the most favorable form of distribution for ignition and combustion, like a great gridiron, to the full force of a neighboring fire. A recent article on the Pittsburgh fire in The Engineering News aptly expresses this in the following words: "There seems to be some irony in calling buildings 'fire-proof' which opposed hardly anything to a fire from across the street more sturdy than plate glass!"

Openings through floors for stairways or elevators, gas, water, steam pipes, and electric wires, from floor to floor of "fire-proof" buildings tend to the spread of flame like so many flues and should be fire-stopped at each story. This fault is more generally overlooked than any other. Ducts for piping, wiring, etc., should never be of wood.

In view of the fact that it is necessary to cover iron with non-combustible, non-conducting material to prevent its exposure to fire and consequent expansion, and in view of the fact that all ironwork, except cast iron, will rust to the point of danger, it is best to use cast iron for all vertical supports, columns, pillars, etc. It is not advisable, of course, to have floor beams of cast iron (except in the form of Hodgkinson beams thoroughly tested). If a floor beam should give way, however, it might not necessarily wreck the building, whereas if a vital column should give way a collapse of the entire structure might result.

At a convention held some years ago in New York, at which were present a greater number of experts in iron than probably ever met before or since in one room, there was not one who contended that cast iron would rust beyond the harmless incrustation of the thickness of a knife blade, whereas there was not one who did not believe wrought iron would rust to the point of danger; and there was not one who claimed to know whether steel would or not, each admitting that steel had not been sufficiently tested as to rust to warrant a reliable opinion. If it could be relied upon as rust-proof, it would be superior to all other material for "fire-proof" buildings because of its great strength in proportion to weight. The use of steel in construction is growing, because it is cheaper than wrought iron, as lighter weights are used for the same strength, but while supposed to be superior to wrought iron, some of the prevailing impressions with regard to it are erroneous. Defects not possible of detection by tests are liable to exist in its structure. Among the first steel beams brought to the city of New York there were instances in which they were actually broken in two by falling from the level of trucks to the pavement, probably due to their having been rolled when too cold, as steel when rolled below a certain temperature becomes brittle. Better beams are now made. In my opinion, cast iron columns are superior to steel and more reliable. It is not generally known that American cast iron is vastly superior to English cast iron, and will stand a greater strain without breaking. Cast iron, moreover, will not expand under heat to the same extent as wrought iron and steel, which is another fact in its favor.

No bearing column should be placed in such a position that it cannot be uncovered and exposed for examination without danger to the structure. One of the ablest architects in New York makes it a rule to so "fire-proof" his columns that they can be examined at any time by removing the "fire-proofing" to determine whether rust has invaded their capacity to carry their loads. In my judgment, examinations should be made, from time to time, in this way, of all wrought-iron or steel columns, as it may happen that a leaky steam or water pipe has worked serious harm. Such a discovery was accidentally made recently in an important New York building. Numerous newspaper paragraphs appear, from time to time, which claim that metal stripped of its covering of cement has been found exempt from rust, with the paint intact, etc., and the fact is cited as evidence that cement is a preservative of iron and that the danger of rust is over-estimated. It is probable that cement will protect paint for a long time, and, of course, paint, if properly put on, will protect iron while the oil in it lasts. Painting, by the way, should be done with the best quality of linseed oil and without the use of turpentine, benzine, or dryers. It should be thoroughly applied in three coats, with about a gallon to 400 square feet, and the iron should be first thoroughly cleaned of rust and dirt, by picking or other process. Paint is rarely properly applied, however, and even when of the best quality, is a preservative of the metal, as already stated, only so long as the oil in it lasts.

Those who claim to have evidence of the exemption of iron from rust rely, I think it will be found, upon iron which has been under exceptionally favorable conditions, free from dampness, the action of gases, etc., overlooking the fact that a leaking water pipe or steam pipe, or the escape of gases from boiler furnaces will attack iron and gradually but surely consume it. A notable instance of this is the case of the plate girder of the Washington bridge over the Boston and Albany Railroad in Boston, where a quarter-inch plate girder was recently found to be entirely consumed in places from the operation of gases from the locomotives passing below.

It is quite common to have advocates of wrought iron cite railroad bridges and the elevated railroad structures of New York as proof of their claims, but if they will take the trouble to examine these structures, they will discover that in spite of the fact that they are exposed to view, that they can be painted frequently, the evidences of rust are unmistakable, especially about the rivets; and one can well imagine what would be the result in the case of riveted iron members in the skeleton structure of a building where such ironwork is entirely concealed from view, periodical inspections being impossible. Rust is especially liable to be found in the cellars and basements of buildings. The wrought-iron friction brakes of freight elevators in the cellars of stores, for example, are frequently found so consumed with rust as to be easily rubbed to pieces in the hand. Steel rivets are dangerous and they should never be used, unless of a very superior quality, so soft that hammering will not crystallize the material, and yet with sufficient tensile strength

*Extracted from the publications of the British Fire Prevention Committee.

to insure perfect holding qualities. This is difficult to secure. Their use in columns for buildings is objectionable, as they rust badly under certain conditions; columns, therefore, should be without rivets, and the beam-bearing bracket shelf on cast iron columns should be cast in one piece with the column. It is generally supposed, and frequently stated, that there is a great difference between the expansion of iron and masonry by heat. This is not the case. For example, the length of a bar which at 32 degs. is represented by 1, at 212 degs. would be represented as follows:

Cast-iron	1.0011
Wrought iron	1.0012
Cement	1.0014
Granite	1.0007
Marble	1.0011
Sandstone	1.0017
Brick	1.0005½
Fire-brick	1.0005

In the "fire-proof" building of the Western Union Telegraph Company, in New York, some years ago, a heavy brick pier, 7 or 8 feet in diameter, adjoined the wall of the boiler furnaces. The difference in expansion in the brickwork next to this furnace wall as compared with that of the remaining brickwork of the pier was so great as to produce a crushing of the material from top to bottom of the pier for a depth of several inches, and it was found necessary to change the furnace wall and leave an air space between it and the pier.

While the difference in expansion between masonry and iron incorporated with it is less per running foot than is generally supposed, and while the difference in expansion between a cubic foot of iron and that of a cubic foot of masonry would hardly be noticeable, especially if the iron were covered on all four sides, yet in stretches of 50 feet or more, as in the case of iron I-beams and girders, the cumulative effect of expansion in uncovered iron might be a serious matter—quite sufficient with the rises of temperature due to a burning building to push out the bearing walls and wreck the building. Especially is this true of temperatures higher than 500 degs. It is unnecessary to suggest that metal differs from masonry in the important respect that heat does not travel throughout the entire length of the latter, while it does in the case of metal. In other words, while the difference between the expansion of a lineal foot of iron as compared with a lineal foot of masonry, marble, brick, etc., is very slight, the difference in conductivity is very great. The conducting power of silver, for example, being represented by 1, copper would be .845, cast iron .359, gold .981, marble .024, and brick .01—an important fact to be considered in the construction of buildings. Brickwork raised to a white heat would not raise the temperature of other masonry in the same wall a few feet away, but one end of an iron I-beam could not be raised to a white heat without raising the temperature of the beam for its entire length.

Where iron beams and girders are inserted in walls without sufficient space left for their expansion under heat they are almost certain to overthrow the bearing walls by their expansion thrust. A large warehouse in Vienna in which such provision had been contemplated by the architect was totally destroyed, with its contents, by reason of the fact that an officious subordinate, discovering the space in the wall purposely left at the end of each beam, deliberately poured liquid cement therein, which, having set, effectually thwarted the well-meant intention of the architect, and resulted in the destruction of the building. The expansion thrust of iron beams may be computed upon the following factor of expansion: Rolled iron of a length of 1,562 feet will expand one-eighth of an inch for every degree of temperature. The heat of a burning building as already stated is enormous—sufficient to fuse most known materials; it may safely be estimated to be at least 1,000 degs.; therefore a length of rolled iron of 1,562 feet at 1,000 degs. of temperature would expand about 125 inches and a 50 foot length of iron girder would expand between 4 and 5 inches, showing that there should be a play at each end of at least 2 inches if the iron is not fire-proofed. Inasmuch as in iron construction the iron beams and girders are usually anchored to the walls to steady them, space should be left and the tie to the anchor should be by a movable hinge joint, which would be of the same strength with an inflexible anchor for all tying purposes, but would yield under the thrust pressure like an elbow and allow play of the beam, or stiff anchors should have elongated holes to allow expansion when beams are of great length. Girders are seldom over 25 feet long, but if bolted together, as is frequently the case, they may be 120 feet or more long, and a line of columns from cellar to roof of a building may easily have one continuous iron structure of two hundred or more feet. It should be remembered, however, that this danger from the expansion of iron may be almost wholly counteracted by protecting it from exposure to fire through the use of non-conducting material. It is more important to protect girders than beams.

The mistaken pride with which the owners of some buildings point to exposed iron beams in ceilings as evidence that the floors are "fire-proof," actually justifying the supposition that they are left exposed for such display, would be ludicrous if it were not serious. In buildings occupied for offices or dwellings, where there is not sufficient combustible material to endanger the beams, it is not so objectionable; but in warehouses and stores, filled with merchandise, such construction is dangerous; and if one of the upper floors should give way it would come hammering down to carry all below and thoroughly wreck the structure. In this connection it is well to say that combustible merchandise should never be stored 100 feet above the street grade even in a "fire-proof" building, since the average fire department cannot reach it at that height.

The roof, that portion of a building which ought to be most carefully watched during construction, is often the most neglected, woodwork entering into the composition, as in the case of the Horne building, at Pittsburgh, where the cornice was supported on wooden outriggers.

Partitions.—These should not be erected upon wooden sills, as is sometimes the case—only, however, with ignorant and inexperienced architects, who suppose that it is necessary to use wood in order to nail baseboards and other trim at the bottom of the partition. Porous terra-cotta will hold nails and should be used in preference to wood, which, as soon as it burns out, will let down the entire partition.

(To be continued).

—At a meeting of the Board of Governors of McGill University, held July 28, Ernest Rutherford, M.A., B.Sc., Trinity College, Cambridge, was appointed W. C. McDonald Professor of Physics, and Dr. James Wallace Walker, of University College, London, was appointed W. C. McDonald Professor of Organic Chemistry. Both the new professors have had most successful careers hitherto, and we hope they will add to their laurels while at McGill.

JAMES MILNE, Mem. Can. Soc. Civ. Eng. Late Gen. Supt. Toronto Incandescent Light Co. Teacher Elec. Eng'g Steam and Steam Engine, Toronto Technical School.

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CANADIAN TRADE WITH SOUTH AFRICA.

A steamship has been chartered to convey Canadian exhibits to the Exhibition to be held shortly in the city of Graham's Town, Cape Colony. She will remain at Quebec till the end of the month to load exhibits. We understand that further information may be obtained from the Department of Agriculture at Ottawa regarding the Exhibition, and that exhibits will be carried and returned free of charge. South Africa is a promising field for Canadian trade. It has been exploited very successfully by American manufacturers and by a limited number of Canadian firms who have had the enterprise to invade that field. For the information of our readers we may mention that the population of Cape Colony at the census of 1891 was 1,527,000, of which 377,000 were whites. The population of Natal was 555,500, of which 42,759 were whites and 43,000 East Indians. The population of Pondoland was 200,000, of Zululand 146,000, Amatongaland 38,000, Swaziland 60,000, Basutoland 218,000, and of Betchulanaland about 66,000; these native territories having so far but a limited white population. The colonies and dependencies just enumerated are all British, but besides these there is the Transvaal Republic under the suzerainty of Great Britain, having a population of about 850,000, of which over 160,000 are whites. Besides the Transvaal there is the Orange Free State with a population of about 210,000, of which 78,000 are white. In the early days of sewing machines the Canadian Wanzer Machine was among the most popular in use in South Africa, and Canadian stoves, office and school furniture, sashes, doors, and house-building material, window shades, bicycles, type setting machines, agricultural implements and other lines of Canadian manufacture, have found greater or less favor in those colonies. American manufacturers, however, have hitherto had the lion's share of the trade because of their greater facilities for shipment and because of their greater enterprise. There is a large market, however, for Canadian goods in South Africa, and it only requires a little investigation to commence on, and a little courage and enterprise to follow it up, to develop a large and steady trade in that quarter of the world. The bulletins which the Canadian Manufacturers' Association propose to publish should serve a very useful purpose in directing Canadian trade into new channels abroad, and in the meantime much can be done by judicious exhibits at such exhibitions as that at Graham's Town.

PURIFICATION OF SEWAGE.*

BY E. G. BARROW, CITY ENGINEER, HAMILTON.

There are few questions of more interest than that of the best manner of disposing of the sewage of our towns and cities, and it may be also said few questions are beset with greater difficulties. When it is considered that this subject has occupied the minds of some of the most practical analysts, engineers and scientists of Europe for many years back, and even at the present day there still exists a great diversity of opinion as to the best method to be adopted, it may well be pronounced a question difficult of solution. It would seem wisdom to avoid becoming a partizan of any particular system, because it frequently happens that the surroundings of a city, the nature of the soil in its vicinity, value of land, etc., dictate the best methods to be adopted in each particular case.

The methods of purification best known at the present time are: 1st. Broad irrigation, or the distribution of sewage over large tracts of land, having in view the growth of useful crops, called sewage farming. This system will take 4,000 to 6,000 gallons per acre per day. 2nd. Land filtration, in which purification is obtained by the passage of the sewage through light soil with little or no attempt to grow crops; 60,000 gallons may be used to the acre on this plan. 3rd. Chemical precipitation, in which the purification is obtained by means of certain precipitants such as lime, alum, salts of manganese, sulphate of iron, which precipitate all the suspended matter in tanks, and also remove a small part of organic matter in solution.

Combinations of the above are frequently made. To these methods have been lately added the septic tank system adopted at Exeter, England; the biological method, by which the purification is sought to be obtained by means of bacteria contained in filters, generally made of coal, coke, polarite, etc.; the treatment lately advocated by Mr. Adeney, of Dublin, Ireland, in which after precipitation with salts of manganese the effluent is treated with nitrate of soda to complete purification.

Ordinary city sewage is a mixture of a very complex character and is derived from the discharge taking place

*A paper read before the Canadian Association of Stationary Engineers.

from water closets, sinks, and also manufacturing wastes, and in those cities having the combined system of sewerage, various substances from the streets. The quality of sewage in different cities varies considerably, the difference being largely caused by the nature of the manufacturing wastes which are received into the sewers. A gallon of ordinary sewage contains about 100 grains of solid matter, 30 grains being in suspension and 70 in solution, 60 grains of which are mineral and 40 organic matter, the analysis of which would yield to each 100,000 parts the following results :

Total Solids.	Suspended.	Alum.	Free Ammonia.	Organic Ammonia.
140	40	20	5	1

What is required to be done is the removal of all matter in suspension and as much as possible of the organic matter in solution. The organic ammonia or albuminoid ammonia is generally considered by chemists to be the most reliable index of the amount of polluting matter present in the sewage. The removal of the suspended matter is at present best done by means of chemical precipitation, but the effluent so obtained still contains organic matter in solution, which unless discharged into a large body of pure water is liable to set up secondary decomposition. The removal of the organic matter in solution contained in the tank effluent may be almost completely done by filters composed of either coal, coke, polarite, land, etc.

The advocates of the biological method of purification say that the matter in suspension may be liquefied by liquefying bacteria, which are cultivated and sustained by the air and sewage contained in the filter, and by this means the sludge would be entirely done away with. But grave doubts are expressed by sewage experts as to the ability of these bacteria or micro-organisms to perform this office, or in plain language they do not believe that they can "get away" with the sludge, and the opinion is generally held that with average town sewage there will be the sewage sludge accompaniment. A writer on this subject facetiously remarked that if the bacteria can be utilized to eat up the sludge, what a pity it is they cannot be trained to drink up all the liquid.

TANKS.

Precipitation tanks are made both circular and rectangular—their capacity being based on the maximum daily flow of sewage. If the quiescent system is adopted the tanks should be so arranged as to permit the liquid sewage to have at least a rest of 1½ hours. If the continuous flow system be adopted, then sufficient capacity must be allowed so that two hours at least will elapse during the passage of the sewage through the tanks. Provision has also to be made for the tank when not in use, and for the first part of storms. Experience has demonstrated that they should be of medium size, as very large ones have been found more difficult to manage. The parts in contact with the liquid sewage must be smooth, and the sludge drains should have quick slopes towards the sludge well. Experience has shown that no danger from freezing may be apprehended in this latitude in winter time. The precipitants most commonly used are lime, alum, soluble salts of manganese, sulphate of iron.

FILTERS.

A well-designed and well-operated filter, all agree, is a most excellent and efficient purifier of sewage. Formerly it was believed that its action was merely mechanical, or that of a fine strainer. Subsequently it was found that those polluting organic matters in solution contained in the sewage which had an affinity for oxygen underwent chemical decomposition and were transformed into new products of an innocuous nature, and this result was brought about by minute living organisms called nitrifying bacteria, so that in fact the purification was chiefly due to these bacteria. A filter should be so constructed that air can permeate its whole structure. It must also have periods of rest. The most modern way is to allow the clarified tank effluent to completely fill the filter so that the liquid just appears over the top of the filter ; after remaining there for about an hour it is discharged by opening a valve situated at the bottom of the filter. Very good results have been obtained, however, by allowing the sewage to be distributed over the surface of the filter by means of gutters, and allowing the liquid to filter slowly through. The filters should be several in number and each allowed a period of rest. The very best results have been obtained from filters composed of coal, the depth being about 4 feet and the sizes varying from ½ inch cubes to 1-16 inch cubes. It is said that coal produces a better effluent than any other substance experimented with, having a chemical as well as bacteriological action. I have been making experiments with coal filters and also with mixtures of coal and slag, and with sand and coke, and certainly the effluent from the coal filter is the best. It is necessary that all suspended matter be removed before the effluent reaches the filter. Sewage disposal has been more studied and has made more advancement in England, Germany and France than in any other parts of the world, but this has probably been caused, especially in England, by dense populations situated on the banks of comparatively small bodies of water (this does not apply to those cities situated on the seaside); whereas in America with the huge fresh water lakes and gigantic rivers into which the sewage is discharged, evil effects are not felt for many years, and it is only when the cities reach a large size that sewage purification becomes necessary and imperative. Now, both in the United States and Canada, cities and towns are beginning to feel the necessity of disposing of their sewage. Much may be learnt by experience gained in Europe, still I am of opinion that climatic differences and other purely local conditions will lead the American and Canadian mind, so prolific in invention, to perhaps improve on the European methods of purification, or at any rate to evolve some plans which will be particularly adapted to the needs of our climate and country.

The following practical deductions from the consideration of this subject suggest themselves: The sewage farm should only be selected when land situated near the city is suitable in character, and below or very little above the sewer outlets, and of reasonable price. If such land is not available and a high rate of purification is required, clarification in tanks by chemicals, followed by filtration, is the best plan. Collect by means of intersecting sewers all sewage to one station, so that all can be under one management. If part of the sewage needs pumping and part could be carried to purification station by gravity without pumping, then two stations might be the most economical. Such would be our case in Hamilton. In building a filter select the very best material, which I would say, without hesitation, is coal. It will give a better effluent and necessitate a less area than any other material.

The researches and experiments made by Mr. Adeney, of the Royal Dublin Society, on polluted waters, are of great value to the subject of sewage purification. He examined the gases contained in polluted water and the changes which took place in these gases, due to fermentation. These changes were caused by living organisms, and he discovered that it was necessary to supply them with oxygen in order to promote healthy bacteriolysis.

This oxygen he supplied by adding pure water (which always contains a certain amount of dissolved oxygen) to the polluted sewage water, and if sufficient was added purification was completed, but if not, putrefactive fermentation would take place. His examination revealed two distinct stages of bacterial fermentation; the first he called carbon oxidation, and the second nitrification or nitro-oxidation. The first takes place much quicker than the last and the liquid during the last stage will generally take oxygen from the air quicker than the organisms take it from the liquid. The conclusion which Mr. Adeney draws is that if the first stage, viz., bacteriolysis, can be made to take place at the disposal works, then the final stage can be allowed to take place in the river or lake into which the effluent is discharged, provided these bodies of fresh water yield the necessary amount of oxygen to complete the last stage of purification. I have thought that the method of purification advocated by Mr. Adeney is worthy of great consideration, as filters in our climate may not be successful unless covered over, and then the cost of roofing would be very great and require frequent repairs. Especially would this be the case in very large works where the filters would cover many acres. The buildings at the sewage disposal works should be neat in appearance, well lighted, ventilated and provided with al modern conveniences for the employees. Garbage destroyers should be built near the disposal works, so that the heat generated may be utilized to raise steam to run the machinery of disposal works, light the works and dry the sludge where precipitation works are in use.

Before concluding this paper I would draw your attention to one very marked improvement effected by our disposal works. Formerly at the outlet of the Ferguson avenue sewer, large quantities of excreta, animal substances, orange peels, paper, rags and offensive matter imprisoned in grease were discharged from the sewer, and at times were deposited by the wind along the shore where it became putrid and rendered the shore of the bay most offensive. Sometimes huge masses floated out into the bay and were deposited at the beach. Now this has been entirely done away with, and although we contemplated putting in filters at Ferguson avenue works, still I believe very good work has been already done.

SANITARY EXCESS.

BY WM. WATSON.

The Surveyor of London, England, reports an important meeting of municipal engineers held in Greater London, on Feb. 25th, to discuss the various methods of deodorizing and ventilating sewers, and to decide upon a uniform system throughout the municipalities, of public sewer ventilation. The meeting was necessary on account of the difficulties encountered by the municipalities (which have unwisely adopted the United States sanitary system) through the almost constant discharge of sewer gases from the ventilation grates in the centre of the street, and the failure of many expensive experiments made with the object of remedying the evil.

The examinations of the drainage plans of a recently built school in the South of England show the dangerous practices persons will resort to to act up to the fashion of the age. The drain in this case is taken the longest way round to the water closets and lavatories, bending squarely three times, and at each bend there is a catch pit or inspection chamber. There is also an interception trap, a breather, and large inspection chamber, which form impediments to the flow of the solids from the closet to the street sewer, causing a sluggish stream, that deposits the filthy matter at each and every angle and at the interception traps, there putrefying and generating gases that will find somewhere an exit and contaminate the atmosphere. The proper way to have drained the school was to avoid any impediments and run the drain pipe lines as straight and direct as possible from street to lavatories and then vertically above to the highest point of the school roof, having all rain-water leaders branched into the sewage pipe line.

The placing of interception traps on private drains cuts off the ventilation of public sewers, which they formerly secured through the house soil pipe that was carried forward through the roof, and the untrapped drain water leaders which, when in action, discharge large volumes of atmospheric air into the public sewers each time the sewage was discharged down the soil pipe, or when rainwater passed down the leader pipes. Then each and every soil pipe and rainwater leader formed a ventilation up cast shaft for the street sewers at short distances of only a few yards apart, which compelled the rapid circulation of fresh air down the surface grates of the streets and up the local pipes to the housetops. All this purifying element is abolished when the American system of sewer construction and the interception trap is adopted. Most cities and towns of Great Britain which have employed that system have to provide for the deodorizing of large quantities of foul gas that is constantly generating in the sewers, because they cannot now get the circulation of air needed to prevent the sewage and solid matter the sewage contains from putrefying during the time they are passing through the sewers to the outfall at the sewage disposal works. Thus we find that the natural ventilation is prevented. On the other hand it is proved that if sewage be not immediately treated by aerating influences it will commence at once to putrefy in the sewers and work mischief, and artificial methods of aeration or deodorizing must be resorted to or the public health will quickly suffer. It is known by experience that artificial means cannot be relied upon, though they are very expensive.

Under the old dispensation, when owners were permitted to put in their drains of broken pipes, bricks, or wood, with no regard for grading, for fall, or tight jointing, often pointing towards and following quite in the wrong direction, and when there were no general rules or designs adopted for the sewage disposal of the municipality on a comprehensive plan, a large number of such drains were totally useless as sewage carriers, and were nothing but cesspools generating sewer gases and distributing poisonous fluid into the surrounding subsoil. The Government became alive to the dangers of these evils and gave permission for each municipality to enforce such improved sanitary regulations as would effectively stamp out such dangerous practices and compel all drains to be constructed with good material and expert workmanship. When the Act of Parliament became operative a swarm of professional theorists, sanitary appliance manufacturers, interested tradesmen and public works contractors gathered round the various municipal authorities and pointed out to them that it was necessary to thoroughly remove the old sanitary abuses, that intricate and costly appliances, coupled with extremely drastic regulations that required an extensive staff of inspectors and other arrangements to apply them, were needed. Most unfortunately for the public health many municipalities were guided by such advisers and adopted their extreme ideas and thus spoiled the good work begun by overdoing it.

When the unnecessarily drastic regulations were enforced they naturally created a necessity for appliances to counteract the evil done. The natural ventilation which

the sewers formerly secured by the large volumes of air carried down the soil pipe by the sewage and rainwater leaders was shut off. The usual and constant circulation of air which formerly passed down the surface grates placed at intervals on the streets, and upward through each soil pipe and rainwater leader to the housetops out of everyone's way, was stopped and the public sewers were then changed from purifiers and destroyers of filth, to receptacles for the accumulation of foul matters and the rapid generators of poisonous sewer gases, which are now found to be very difficult to handle.

To try and destroy the evils thus created, various methods have been tried, and amongst a large number a few of the principal ones may be here mentioned, viz.: The flushing of sewers by water wagons and also automatic flushing appliances, and by creating a current of air with the heat from gaslights burning in the sewers; by connecting the head of each line of sewer o a tall ventilating shaft, or to a manufacturer's mill chimney, or into the ashpit under the steam boilers; by building vaults under the surface, ventilating grates in the streets, and installing deodorizing chemical evaporating machines intended to destroy the foul odors. When these artificial means are put in practice it is found they have each disadvantages unknown to the old natural ventilation processes. It is proved that having one ventilation shaft at the terminating head of each line of sewer is not sufficient, that air shafts are needed between each and all the street grates; that gaslights cannot be made reliable, for they occasionally either smother or blow out and then add to rather than reduce the nuisance. Flushing sewers allow plenty of time for the manufacturing of sewer gases between the periods of flushing, and ventilation is needed even when flushing is adopted. When chemical evaporating machines are used they need to be numerous, one for each grate, and even then the pressure in the sewers due to the want of circulation of air is often such that it forces the poisonous gas through the interception traps, which then passes either into the dwelling through the fixture traps or out of the breather pipes in front of the buildings on which they are placed at a level of within one foot of the ground line. All such apparatus are expensive besides and require constant attention and renewal.

The meeting of municipal engineers and surveyors already mentioned, after discussing the advantages and disadvantages of the different artificial methods of deodorizing sewer gases, decided to advise all municipalities to adopt so much of the old system of sewage ventilation as to ventilate each private drain by taking a branch pipe from the sewer side of the interception trap up to and above the top of the buildings. This is very good by just so much as it returns to the former systems of natural and local ventilation, but it still leaves the interception trap in each private drain that forms a catch bag, and often retains the solids of the sewage that passes through them, and in a short time chokes the private drain and totally disorganizes the house sanitary appliances; it also spoils and destroys the ventilation of the house soil pipes, because when there is any interception between the street sewers, and the terminating end of the soil pipe above the roof, it prevents the warm air of the street sewers from constantly moving upward through the vertical soil pipe and carrying along with it any foul gases that might generate in the waste pipes. To rely upon an upward circulation through a breather pipe placed at the foot of a house drain often fails altogether, because the current of air is sometimes changed to pass down from the roof to the ground line in place of passing upwards, first by the sewage passing down the soil pipes and carrying down large volumes of air with it, which is discharged at the ground line by the breather; second, then very often the breather pipe is not in working order through being choked, and third, by the variations in the temperature of the atmosphere.

The result of the surveyors' meeting proves that the expensive sanitary excesses and the interception trap is a total failure, but that the cost of the system has been thus far heavy and the standing and the reputation of the theorists have to be shielded, so that the intricate and obstructive system must be withdrawn slowly, even if by so doing they still further increase the cost of sanitary appliances. Let sanitarians compare the United States sanitary methods which have been adopted by Greater London and a few other towns of Great Britain, with the large stuff manufacturing city of Bradford, England. The authorities of that city have done everything possible to assist nature to keep their sewage sweet and odorless in the sewers until it arrives at the outfall of the sewage disposal works at Frizenall. The city is crowded to excess with large manufactories and dyeworks that discharge an enormous quantity of dirty or greasy water into the common sewers daily. And 90 per cent. of the population are employed in close greasy factories or other workshops; they live in houses closely built together, yet the inhabitants enjoy general good health, and their death and sickness rate will compare favorably with any other town, even where that town enjoys much more favorable circumstances. This can be largely attributed to the plain and efficient sanitary regulations enforced, and to the adoption of nature's laws in carrying out the principle of domestic sanitation. They do not allow bath or other small waste pipes to be connected directly with the street sewers, but each delivers its contents into an open grid and gully trap which conveys the sewage to the street drain. No sewer pipe which is connected in a direct way with the street sewer enters under any building except to serve a w.c.; then it is constructed of heavy lead or other good metal and joints. Soil pipes that serve water closets in upper rooms are run up outside the building when practicable, and the w.c. bend is taken through the outer wall at the nearest point and connected with the soil pipe outside, and the pipes fixed in this way work all right in frosty weather though the city is visited with long and severe frosts and snows in winter. They also put in as short a length of soil pipe as possible to do the work efficiently; weeping tile drains are never connected with any sewer drain, but deliver on to an open gully grate outside at the bottom of an area window if convenient. The sewage collecting sewers are generally taken along the back lane when the whole of sanitary appliances are in the rear rooms of the dwellings. If allowance be made for the smell that must come from the numerous open privy middens and the slop-water closets which Bradford still uses in many houses, then the city of Bradford is about the sweetest and healthiest manufacturing town that can be found. I may also say that they do not as a rule use back air vents to water closets; and it is unnecessary to use them for the traps, serving baths and any other small fixtures, because they are not connected directly with the sewers.

John Burke, Esq., North Bay, has secured a contract for lighting the streets of North Bay by electricity, and has placed an order with the Canadian General Electric Company, for a 25 light wood arc dynamo, and 15-double carbon brush arc lamps.

THE VICTORIA JUBILEE BRIDGE.

The Victoria Jubilee Bridge, on which such rapid progress has been made during the past few months, is well under way towards completion; in fact, it may be already said to be completed as far as being self-supporting is concerned, for no portion of it is now dependent upon the erection trusses, and the double line of rails will be laid throughout, just as soon as the old tubular bridge is removed. The work of erecting the superstructure of the first span from the westerly end was commenced on the

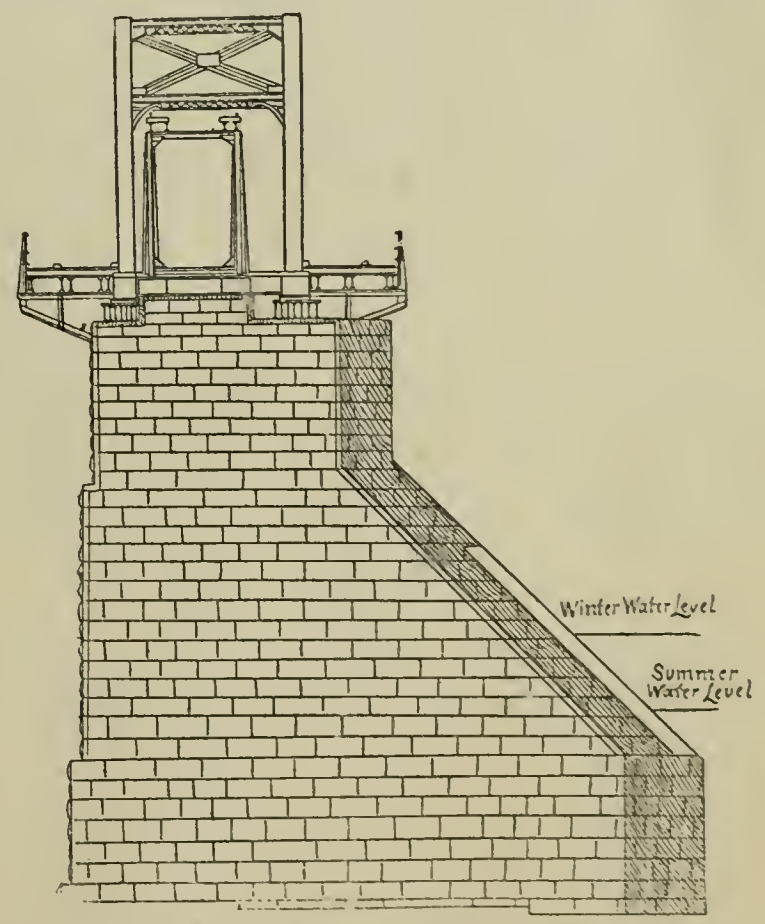
VICTORIA JUBILEE BRIDGE, MONTREAL, SHOWING UNFINISHED CENTRAL SPAN. THE VIEW IS FROM THE ST. LAMBERT SIDE, ABOVE THE BRIDGE.

8th December, last year, and it was completed on the 25th of the same month; but as it was almost impossible to carry on further operations during the winter season, the work of erecting was suspended until last spring. The second span was commenced on March 23rd, and the work progressed steadily during the season, with the result that on the 19th August the central span, which was the last one to be done, was all coupled up and resting upon its own bearings, thus practically completing the bridge proper. This has certainly been rapid work in bridge erecting, considering that between the 23rd March and 19th August, twenty-three spans, of 254 feet each, for double railway tracks and double tramways, and one 348 feet central span, of similar capacity, were erected in place, and that during this period of five months the aggregate amount of time that the present single-track bridge was closed to train service was only twenty-five hours.

The method of erecting the 254 feet spans has been described from time to time, and was carried on throughout on the same general principles. A temporary truss of as light a character as was compatible with what was required of it, was erected in proper axis on the ground at the entrance to the present bridge, and traveled across the tube by means of a series of trucks moving on the rails on top of the tube. Blocking was placed on these trucks to carry the truss by means of its top members, and the wheels were so placed as to distribute the weight as uniformly as possible in passing over the tube. The temporary truss was then drawn across the tube by means of block and tackle, worked by a stationary engine, securely placed on the top of the next tube.

As instance of how perfect the arrangements were for the moving of this temporary truss, it may be stated that the time occupied in the actual passage from pier to pier was only from four to six minutes in each case. After this truss had been placed exactly over its bearings on the piers it was lowered into place and the entire weight removed from the tube. During its passage over the present bridge and until it was securely placed upon its own bearings on the piers no trains were allowed to pass through the tube. This temporary truss being twenty-six feet two inches wide and thirty-four feet ten inches high, centre to centre of post and chords was therefore completely clear of the tube, and was then used as the staging for the erection of the permanent bridge. There were two erection trusses, one on each side of the centre, and as each permanent span was completed, the erection truss was moved in a similar manner for the erection of the next one.

The central span being so much greater than the others required a different method for the temporary work, and therefore the two erection trusses were used to form one. The plan adopted was unique; the one used on the westerly side of the centre was cut in two, and one portion of it removed to the easterly end of the one used on the easterly side. On the portion that remained some extra members were placed, forming a cantilever arm, and it was moved forward into position over pier No. 12, and securely anchored to the permanent bridge. On the half that was taken to the easterly side a similar cantilever arm was attached, and on August 7th the erection truss which had not been divided was traveled westwardly over the centre tube intact, in a similar manner to the others, and the pins driven connecting it with the west cantilever arm. The east end cantilever was then moved over pier No. 13, and after it was adjusted to proper position the pins were driven connecting the cantilever arm with the truss and it was firmly anchored at the east end to the permanent bridge.



THE ELEVENTH PIER AND SECTION OF TWELFTH SPAN.

The blocking on the trucks which supported the truss and carried it across the tube was then removed and this temporary span then rested on its own bearings, all foreign weight being entirely removed from the tube. Notwithstanding the exceptional care which had to be exercised in placing this truss, the time that the present bridge was closed to traffic was only five hours.

In regard to work remaining to be done in connection with the bridge proper the removal of the old tubes will be

the most laborious; the first span of the tubular bridge has already been taken away and it may therefore be said that that portion of the new structure is now in active use. The cutting of the rivets of the old structure and the removal of the various plates, girders, etc., entails an immense amount of labor, and it is of such a nature, and the field for operation is so limited, that the greatest care and caution have to be exercised in this particular part of the work, more especially on account of the incessant traffic moving in either direction.

VICTORIA JUBILEE BRIDGE, MONTREAL, SHOWING OLD TUBE SURROUNDED BY NEW STRUCTURE.

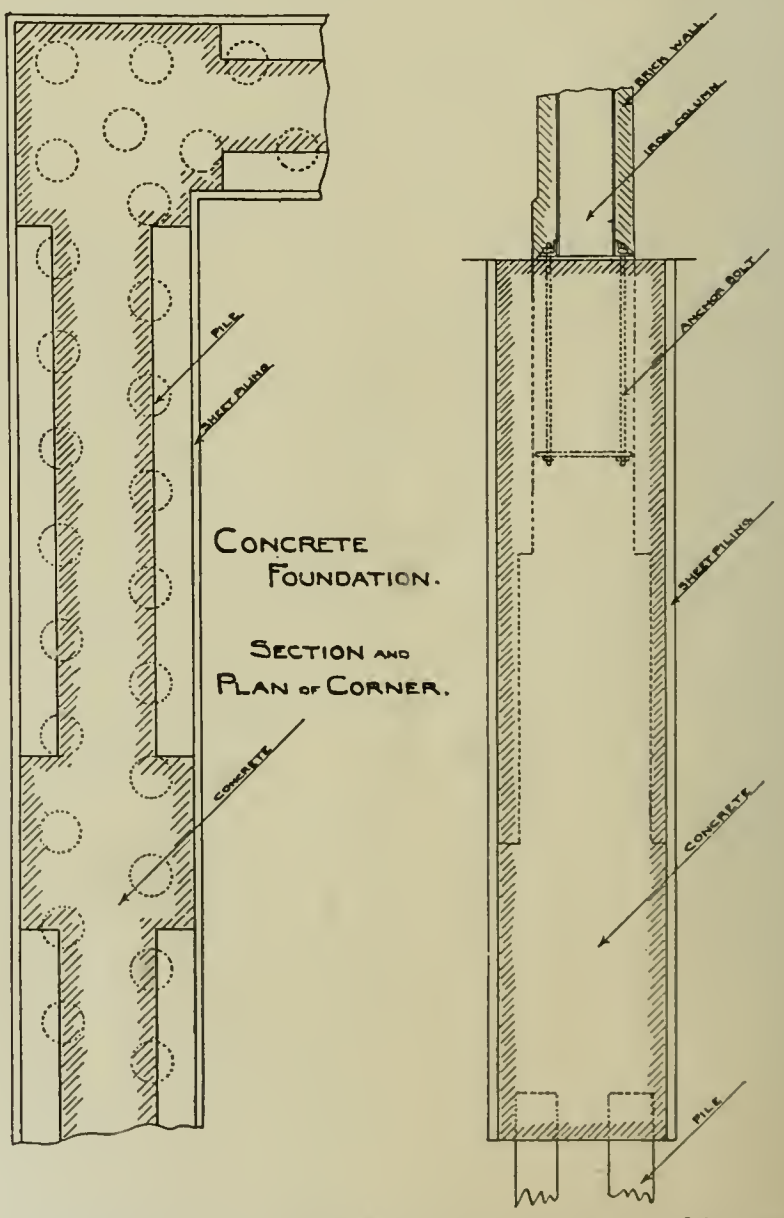
The old tubular bridge, as is well known, is a single-track structure, with a minimum clearance in height of only 15 feet. The new bridge will have a double line of railway tracks and a clear headway of 22 feet 6 inches. It will also have a team roadway and sidewalk on either side of the bridge outside the main trusses, which will be carried by the floor beams extended beyond the trusses. The total length of these floor beams is 66 feet. By way of comparison it may be interesting to note that the weight of iron-work in the old structure is 9,044 tons, whilst the new contains 22,000 tons of steel. Amongst other work yet remaining to be done is the widening of the embankment approach to accommodate the team traffic, but that is a minor matter, and will not interfere during its construction with the train traffic, nor yet with the bridge itself.

A CONCRETE FOUNDATION.

A somewhat unusual foundation has just been built for a new generating house the Consumers Gas Co. is erecting on Parliament street, Toronto. We believe it is the first of the kind in Canada. The building is to replace one that had to be torn down on account of the numerous cracks and settlements developed by faulty foundations. The foundations for this heavy building were simply rubble stone walls in lime mortar, walls that were built without any through bonders, plenty of "shiners," straight joints, parts laid up dry and all small stones; consistently with such work the walls were largely built on a soft made up bottom, one wall was carried down indeed sixteen feet below the ground level as if in search of hard bottom, which not only caused useless expense in the first instance, but also made the expenditure greater in the new work. Had piles been driven from four or five feet below the surface all round the building until they either gave an equal frictional resistance or reached hard pan, the first building would have cost less than it did and still be standing. This is a glaring instance of the greater costliness of rule of thumb methods in building over more scientific ones.

When the old foundations were removed the architects had test piles driven at intervals of about ten feet along the trenches and found the bottom to be so soft that the piles sunk to rock without practically developing any frictional resistance. Calculations were made therefore on the basis of the piles acting in direct compression, and from data thus gained it was determined to drive a double row of piles in the trenches at two feet centres staggered. These piles averaged a depth of about twenty-six feet from the ground level. They were cut off perfectly level twelve inches above the bottom of the trench and concrete filled in between to an even surface with the tops of piles, this thoroughly keyed the piles together and gave a good bed to build on.

On the recommendation of the architects, Bond & Smith, Toronto, solid concrete walls were then built to the ground level, part being sixteen feet deep. With walls such as this the loads from the superstructure (a steel skeleton building) are quite evenly distributed on the piles; Another point is that the column bolts are bedded right in the concrete mass and the whole is cohesive and rigid. The walls were stepped up in thickness from 3 feet 6 inches to 2 feet 3 inches.



The method of mixing and laying may be of interest: The concrete was formed of five parts of small broken stone, two of gravel and one of cement. After carefully examining tests of various cements a Canadian brand was specified by the architects, the Samson brand of the Owen Sound Portland Cement Co. All proportions were carefully measured in barrows of equal capacity, the stone was thoroughly wetted before being mixed with the other materials, the mixture was turned over four times to ensure thorough covering of the stone, only enough water was allowed to be added to make the mass cohesive, it was

then placed in the trench and tamped until the water came up to the surface. The walls were made in layers of not more than eight inches and wherever a joint occurred the layers above lapped over at least five feet in either direction; always before starting a new layer the lower one was "ragged" up, swept clean and watered thoroughly.

It is somewhat strange that this method of concrete foundation walls has not been more extensively used, for it is not only superior to an ordinary bonded wall, but has been found to be cheaper than a stone wall properly built in cement; doubtless though we shall see it adopted more often in the future now that a beginning has been made.

Some difficulty was experienced in carrying out this work through the heavy generators bearing on the ground a few feet from some of the trenches. On this account before allowing the old walls to be removed three-inch sheet piling was driven sixteen feet down. As the stone was taken out wales were placed along this and carefully strutted. At one of the other trenches it became necessary to underpin the stone wall of adjoining building before proceeding with the work.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NINTH ANNUAL CONVENTION.

The ninth annual convention of the Canadian Association of Stationary Engineers was held at Hamilton, on the 8th, 9th and 10th August. The hotel headquarters were at the new Waldorf House, and the meetings were held in Oddfellows' Hall, John street.

The first session opened at 11 a.m., on Monday, 8th, with president, Bro. E. J. Philip, of Toronto, in the chair, and vice-president, Bro. W. F. Chapman, of Brockville, in the vice-chair. The other executive officers present were, J. G. Robertson, Montreal, secretary; R. C. Pettigrew, Hamilton, treasurer; G. C. Mooring, Toronto, doorkeeper. The delegates present from the branch associations were: Charles Moseley, John Fox, Wm. J. Webb, and Thos. Eversfield, of Toronto No. 1; John M. Dixon and John J. Richardson of Toronto No 2; Thos. Ryan and Peter McNaughton of Montreal No. 1; Geo. Mackie of Hamilton No. 2; Chas. Asselstine of Kingston No. 10; Wm. Allan, of London No. 5; John Grundy, of Brockville No. 15; Wm. Bear of Dresden No. 8; Wm. Oelschlager of Berlin No. 9; Thos. Pilgrim of Brantford No. 4; and John L. Wendell of Waterloo No. 17.

Other members reported present were the officers of Hamilton No. 2, consisting of Robt. Mackie, president; W. R. Cornish, past president; Thos. Chubb, vice-president; Joseph Ironside, recording secretary, James Carroll, financial secretary; Wm. Nash, treasurer; W. I. Stevens, conductor, and Thos. R. Carter, doorkeeper; Peter Stott, T. Cook, C. Hurton, J. Webb, T. Elliott, C. De Mille, W. Morris, J. Wadge, J. Clair, J. Fielding, David Hunter, Robert Stewart, J. M. Morris, and G. Epps, all of Hamilton; Geo. Gilchrist, Geo. Bradley, A. M. Wickens, Samuel Thompson, Walter G. Blackgrove, J. G. Bain, John Ruse, P. Trowern, all of Toronto; F. G. Mitchell, of London.

Among the visitors present were J. E. Taylor, representing the International Correspondence Schools, Scranton, Pa.

Executive treasurer Pettigrew, having introduced Mayor Colquhoun, and Aldermen Carscallen and Nelligan, of the Hamilton city council, the Mayor came forward, and in the name of the council and citizens, welcomed the association to Hamilton. The duty demanded of him was a pleasing one, for societies with such high ideals as this should meet with hospitality and friendship, wherever they convened. His chief regret was, that owing to the restrictions of a city by-law, which was as unchangeable as the laws of the Medes and Persians, he could not offer them the use of the City Hall as a meeting room, but he was glad to see they had comfortable quarters and plenty of room here. He hoped the delegates would carry back with them the most kindly recollections of their visit to Hamilton. They would be welcomed and "taken in"—using that phrase in a hospitable sense—and they would find the people of Hamilton kind and fraternal. Hamilton was a city to be proud of; it was of no mushroom growth; there had never been a boom since 1856, but its growth had been a steady, legitimate one, and that was what they wanted. Hamilton was now becoming known as one of the prettiest cities on the continent of America—an assertion with which the visitors would agree, he believed, before the convention was over. He might say more, but he was not an adept at figures of speech. As a banker he was more familiar with the figures that could not lie (laughter). In conclusion, he welcomed the delegates collectively and individually, and trusted their convention would be both pleasant and profitable.

Alderman Carscallen wished to emphasize the welcome extended by the Mayor, and was glad the association had seen fit to choose Hamilton as a convention city. He had been struck with the principles of this association, as announced in the preamble of the constitution, which he begged leave to quote: "This association shall at no time be used for the furtherance of strikes, or anyway interfering between its members and their employers in regard to wages, recognizing the identity of interest between employer and employee, not countenancing any project or enterprise that will interfere with perfect harmony between them; neither shall it be used in any manner for political or religious purposes." As long as this association is conducted on those principles, it would have the respect of every right-thinking man, and he would admonish all the members to adhere to those principles. He had always been in favor of organized labor, for the improvement of the condition of the workingmen, and as a means of obtaining their rights; and he had no hesitation in saying that the organization of labor had been the means of lifting men up. Union for mutual help and defence of interest was reasonable and seemed to prevail. As a councillor of some years' experience he would advise them never to be hasty in amending the constitution. A proposition might appear reasonable at first sight, but on second thought it would be seen to be a mistake. He hoped their deliberations would redound to the credit of the association.

Alderman Nelligan also expressed the pleasure it afforded him to join in welcoming the association to Hamilton. In the city council he was an advocate of day labor, as a means of getting good and efficient work, instead of awarding municipal work to contractors, who would squeeze the men and get all the profit there was in a job for themselves. He hoped the delegates would have a good time, and be pleased with their stay in the city.

Bro. Robert Mackie then read an address of welcome on behalf of the Hamilton branch, as follows:

"On behalf of the Hamilton Association No 2, I have a great deal of pleasure in extending to you, delegates of the Canadian Association of Stationary Engineers, at our 9th annual convention, a hearty welcome to our city. We might say that you are not strangers in a strange land, for you have been here at a former meeting of this kind, the Executive having been formed in our city. The continual growth of the association, however, has brought with it a larger number of delegates. It is not necessary to go into details of the advantages of engineers belonging to such organizations as ours. The members of the Hamilton branch received a great deal of valuable information last winter by a series of addresses and papers on subjects in which we are all deeply interested, given by the best authorities we could procure. In conclusion, we trust your stay with us will be a very pleasant as well as a profitable one."

The president appointed Bros. Ryan, Wickens and Blackgrove a committee to draft a reply to the addresses of welcome.

The president gave his annual address as follows:

I have the honor and pleasure to welcome you to this the 9th annual convention of the C.A.S.E. The subordinate associations have chosen you to represent them at this convention, and to look after their individual interest in particular and the whole society in general. The second meeting of the executive—it was really the first, the previous one being only a meeting to get into shape—was held in this city, and I little dreamt at that time that I would occupy the president's chair

at the next meeting in Hamilton; therefore, it is with pleasure that I greet you, the new members and the jolly good fellows I have met before. While this meeting should be a criterion by which we can judge the growth of the association, we must not forget the conditions under which the C.A.S.E. is carried on. First, it is not a labor organization, nor is it an insurance society, and it cannot be called a secret or benefit society, nor is it a political or religious order, it is purely an educational institution. Therefore the growth of the order is limited for several reasons. First, we have not the attraction that insurance, secret, benefit or labor organizations have. The field from which we draw our members is limited and scattered, and there are few places where there are plants enough to get a number of engineers to join an association; another reason is the fact that as boys at school hate to be taught, so we grow up, and it is hard to get a man to realize that he has much to learn, and as education is the only object for joining the association some object to letting the public know that there is anything yet for them to learn. Now, while the growth of the order is apparently small, at the same time the percentage of good done its members is much greater than any other order that I know of, as many can testify to. We meet again here this year to try and work out other ideas for the benefit of the order and each member individually. I hope you will all give your attention to the business that will come before you, that our meeting here may result in profit to ourselves and prosperity to the society. The prospects for the coming years are brighter than for years past; times are good in this country, and when the war is settled the big country to the south of us will brighten up and their prosperity will add to ours. So that if we grew in the past few years we will boom in the next. Hard times have had their effect on this order like all others, but hard times are a thing of the past in this country, and will be for some time to come, if I am any prophet, and if those who have been the stay of the association in the past will keep on pushing they will reap the harvest they have been looking for. Better work has been done in the subordinate associations during the past year, in the line of reading papers and making the meetings entertaining and instructive than other years; and it is noticeable the improvement in lodges where this matter is thoroughly carried out. I am pleased to state that Hamilton No. 2 is carrying this work out to perfection. There was one new association formed during the year in Toronto. It is a good live association and will materially help the order in Toronto and vicinity. The matter of a hand-book taken up last year was completed this. The secretary will no doubt make you a full report on the matter. I have not had the time to give to executive business that I would like, from the fact that this has been the busiest year with me that I have ever experienced, in fact, it was very difficult to get away to attend this convention; in consequence of this the work has all devolved on the secretary, and, as in past years, the secretary is by far the more important officer of the executive. So much so that it has been suggested that a permanent secretary be appointed, or at least have the secretary hold office for more than one year. As it is now, it takes a man the entire year to get accustomed to the work, and then he is changed, making confusion and loss of time to both executive and subordinate lodges that would be avoided by a permanent secretary. In conclusion, brethren, I hope you will give me the support that you have given the chair in the past, and that you will attend strictly to business while there is business to be done. I wish it were in my power to do all for the C.A.S.E. that I would like, and place it at the head of all societies, where it belongs, because it is founded on education.

Bro. Wickens regretted that duties in Toronto would call him away from the convention for the following day, but as he took a fatherly interest in the organization, having been one of its founders, he desired, with the president's permission, to make one or two observations before leaving. There were many different associations in existence, with various objects in view, but no association bearing on trade could be named which existed for the special purpose of educating its own members. The C.A.S.E. did this, and spent hundreds of dollars for the educational advancement of its members. How to extend and develop the educational plans of the association was a problem. Many engineers were scattered over a wide extent of territory in Canada, in many places it was not possible to form a branch association, and how to extend these advantages to such engineers was a problem worthy of consideration. He was glad to see city aldermen here, and would be glad to see city fathers in other places take an interest in our association. It was well for them to know that this association existed as much for the steam user as for the engineer. If the ideals of the association are lived up to, there was nothing to prevent it from becoming one of the greatest organizations in the country.

Secretary Robertson then read the minutes of the last convention, which, on motion of Bro. Moseley, seconded by Bro. Mooring, were approved.

President Philip nominated Bros. McNaughton, Mooring and Geo. Mackie to be the Committee on Credentials.

In the absence of Bro. Risler, of London, Bro. Allan, of the same branch, was appointed conductor.

Bro. Oelschlager, of Berlin, said, that as he would not be able to remain throughout the convention, he would take this opportunity of inviting the members to hold the next convention in his town. Berlin could not boast a big river or lake, but it had other attractions, and was becoming known as a convention town. Berlin was a prosperous manufacturing town, and he could assure the members that if they accepted his offer they would find a hospitable welcome.

Bro. Wickens approved of the idea, as Berlin and Waterloo, which were almost one, had each a branch association, and the Berliners knew how to take care of a convention.

The formation of committees was then proceeded with, as follows, the first-named member in each case being chairman:

Committee on Audit—Bros. Webb, McNaughton and Bear.

Constitution and By-laws—Bros. Ryan, Mooring, Allan, Pilgrim and Geo. Mackie.

Good of the Order—Bros. Dixon, Chapman, Eversfield, Moseley and Richardson.

Mileage—Bros. Pettigrew, Robertson and Fox.

Bro. Ryan gave notice of motion to have the following changes made in the constitution and by-laws:

1st. That the per capita tax paid by the different sub-associations be reduced from 70 cents per member, as at present, to 50 cents per member. .....

2nd. That with a view to reduce the expenses of the Executive Council, the meetings of the Executive be held biannually instead of annually.

3rd. Also with a view to reducing expenses, that the election of doorkeeper and conductor be dispensed with, and that these offices be filled at the convention by any delegates appointed by the president.

4th. That no District deputy be appointed by the president, but that all the executive officers fulfil the duties of District Deputy in different localities at any time.

5th. That all past presidents be competent to form part of the Executive Council with full powers and privileges, but that no mileage or hotel expenses be paid to any past president.

Bro. Wickens gave notice of motion that the Committee on Constitution and By-laws be requested to formulate a set of by-laws for the subordinate associations, and report the same at next convention.

The convention then adjourned till

TUESDAY, 9TH AUG.

The first business of the day was the presentation of the executive secretary's report. Secretary Robertson reported that during the year a new branch association had been formed in Toronto, known as Toronto No. 2, and they had succeeded in resurrecting the two defunct branches, Stratford and Wiarton. From Guelph, Ottawa, Winnipeg, Kincardine and Peterboro no report had been received as to per capita tax. The receipts of the year were $555.99, and after paying expenses the association had a balance on hand of $290.04. These figures did not include the expenses and receipts of the new handbook, which had not been issued long enough to enable them to make collections. This handbook had been compiled with a view to making it as useful as possible to the average engineer, and it had been exceedingly well received. It was acknowledged to contain more information than many books of five times its price. It was too early yet for the association to reap the full benefit from it, but that would come in the future. The financial results from it would be fully reported on at the next con-

vention, and meantime he might say that he hoped to turn in several hundred dollars to the association from it.

On motion of Bro. Pettigrew, seconded by Bro. Allan, the report was adopted, and Bro. Robertson and his co-compilers of the handbook were congratulated on their excellent work in producing such a valuable book at so much labor and trouble to themselves.

The Treasurer's report was as follows:—

The Treasurer begs to submit the ninth report of the Association.

Balance from last convention and receipts of the year	$559 99
Expenditure	269 95
Balance on hand	290 04

ROBERT C. PETTIGREW.

Auditors: W. J. Webb, Wm. Bear and P. McNaughton.

On motion of Bro. Mooring seconded by Bro. Asselstine, the report as passed by the auditors was adopted.

Bro. Ryan presented the report of the committee on constitution and by-laws as follows: This committee recommends unanimously the following:

1st. That the per capita tax be reduced to 50 cts. per annum for all members in good standing.

2nd. That the doorkeeper and conductor be not elected but appointed by the president from the delegates present at each meeting of the Executive Council.

3rd. That in article 10 section 1 the word "deputy" shall be struck out and "Executive Officer" inserted.

4th. That all past presidents remain members of the Executive Council with full privileges, but they must defray their own expenses.

5th. That the committee does not see its way clear to hold its conventions bi-annually.

Bro. Dixon presented the following report of the committee on Good of the Order. Your committee appointed to consider this important portion of our Society's life and development, have given due thought to the many suggestions that have been presented, and would submit the following conclusions to the mature judgment of the convention.

The president's report in a spirit of fraternity, welcomes all to take part in the convention. He further adds that our society is neither a trades or insurance association, and consequently our expenses should be reduced to a minimum. The educational portion of our meetings should have some form of systematic teaching, and all who are able should be asked to participate in this necessary and useful work. We believe that an advance in this direction would be instrumental in raising our organization to a permanent and educated membership.

We believe the time inopportune to change the per capita tax as the executive have liabilities which must be met for the current year, and any action taken in the matter might be a source of discredit to the order at large.

The suggestion of bi-annual meetings we regard as a fatal blow at our very existence. The vitality of a society consists as much in its intercourse and annual settlement as it does in its financial strength, and while the desire to economise may be commendable, yet we regard this step as one which in a measure would be suicidal.

The cutting off of doorkeeping and conductor proceeds from the desire to further economise, but we submit that such a course may act prejudicially, inasmuch as the conferring of this honor on members of small or remote associations keeps a thread of connection that is frequently of eminent service to the Order.

The services of district deputies should be dispensed with, and in the locality requiring the service of an executive officer, any member of the executive should be delegated to discharge the duties of the office.

The bulletin at present issued monthly to the associations should be enlarged to an 8 page Journal. It could be made an avenue of interest and information to our membership, besides it could be placed in the hands of those eligible to join our ranks, and possibly add materially to our numerical strength. We are further of opinion that such a sheet, by proper management, could be issued free of expense by a judicious system of advertising.

The office of executive secretary is one that should be held for more than one year, as a greater degree of perfection could be reached in secretarial work by a continuous service. The price of stationery as furnished to primary societies is on the side of excess, and we would suggest that a reduction of 10 or 15 per cent. should be made on all future sales.

It is a matter of regret that our bill in the Dominion Parliament was thrown out on a technicality; but we trust the combined wisdom of the present convention will devise some method wherein our profession may have due recognition and legal protection.

Both reports were received, to be discussed in detail later on. In the meantime a general discussion took place on the effect of the proposed changes.

Bro. Ryan said other organizations larger than this had got into trouble through fixing their per capita assessments too high, and there were some members of the Montreal association with whom this was a serious matter. Bro. Moseley wanted to know, if this tax were reduced, where the funds would come from to make up the deficiency. Toronto No. 1 had no complaint to make, as it had double the membership of any other branch; but a reduction all around would leave a shortage. He thought it should be left for another year. Bro. Pettigrew was in favor of a reduction and the association was now in shape to make it. Bro. Dixon said that big societies could afford to have a low assessment. He wished to be on the side of economy, but the present time was not opportune, and the branch association should be consulted in such a matter. Bro. Robertson said that as far as the immediate future was concerned, the association at large really depended for its income on the handbook just issued.

After further discussion Bro. Dixon moved, seconded by Bro. Richardson, that the executive secretary issue a circular to all the branch associations, asking them to state their financial position and express an opinion on the question of reducing the per capita tax, a report to be presented on the subject at the convention of 1899.

In speaking to this motion, Bro. Ryan said Montreal No. 1 had already instructed him on the matter. Bro. McNaughton said the dues to the branch associations barely covered the expenses, and if the per capita tax were reduced it would give them a fund to work upon. Bro. Moseley said Toronto No. 1 had been able to make way and pay out $200 in sick benefits in the last two years besides. Bro. Asselstine said Toronto was exceptionally well fixed. In Kingston, they found the tax quite a burden. Bro. Robertson said the big branches should help the little ones, if they wanted to see the institution grow; but he did not see how they were going to reduce the tax. President Philip, in reply to a question, said the proposed change in the officers would take off about two-thirds of the average loss from the reduced tax. On motion of Bro. Robertson, seconded by Bro. Moseley, the discussion was deferred; Bro. Dixon's amendment being lost.

On resuming discussion on the report of the Committee on Constitution and By-laws, the first clause, proposing to reduce the per capita tax, was defeated.

On the second clause, Bro. Dixon thought that if these offices were retained, the delegates elected—especially if from a small branch—would go back to their branches as apostles of the association. Bro. Ryan held that there were as good men in the small branches as in the big ones for any office, but as these offices could be filled by any delegate present, it was only throwing money away to have them as a part of the executive machinery. On being put to vote, the clause was rejected, and the offices of doorkeeper and conductor retained.

Clause 3 was adopted, the effect being to do away with the "district deputies," and make each executive officer an organizer in the district in which he may be visiting, or may reside.

Clause 4 was also carried, giving past presidents the right to vote, etc., at conventions, but without transportation allowance.

Clause 5 was also approved, maintaining the conventions annually, as at present.

On taking up the report of the committee on "Good of the Order," the president said Mr. J. E. Taylor, of the International Correspondence Schools of Scranton, Pa., would like to address the convention on the educational question. Permission being given, Mr. Taylor gave a history of the begin-

ning of this institution, which was founded by T. J. Foster, first as a means of preparing miners and mine engineers to pass the examination required by the State of Pennsylvania, and afterwards as a more comprehensive system of technical education for steam engineers and firemen, electricians, machinists, mechanical draughtsmen, designers, etc., to be carried on by correspondence in any part of the world. When the State law, requiring the examinations, was passed, many of the miners were in a difficulty, and Mr. Foster was asked to help them out by a set of questions and answers. It was thought that a class of 300 might be obtained at first, to cover expenses, but when the plan was placed before the men, 1,200 applied, and the idea has since developed, till now the I. C. schools have 50,000 students throughout the world. The student is taken right from the a b c of arithmetic up through algebra, etc., and as a correspondence is carried on personally with each student, a fair chance is given to backward pupils. The postage bill of the institution averages over $1,000 per week. Recently a kind of employment bureau has been started for obtaining situations for students, after they have passed, and a case was cited where the institution had been the means of obtaining situations for three young tool makers, at wages of $3.50 per day. The schools have 15 printing presses run by electric motors, and consume about two tons of paper per week.

A special discount was now offered to members of the C.A.S.E., and Mr. Taylor was prepared to explain all details to members interested. A branch office is being opened in Toronto, particulars of which are given in another column.

On motion of Bro. Dixon, seconded by Bro. Richardson, it was decided to recommend the methods of this school to the consideration and support of members.

On the question of continuing the issue of the "Bulletin," published for the past four months, Bro. Robertson explained that it was got out to advertise the work of the Engineer's Handbook, 1,000 copies per month being printed. It had served that purpose well, and the question now remained as to its continuance, either as a 4-page or an 8-page paper.

After further discussion, a committee, composed of Bros. Ryan, Dixon and Robertson, was appointed to confer with the publishers of THE CANADIAN ENGINEER in regard to the issue of the bulletin.

The convention then adjourned to hold an excursion on the steamer "Acacia" during the afternoon. About 50 joined in the trip, the steamer crossing Hamilton Bay and making a trip several miles out into Lake Ontario. A lunch was served on board, and the trip was enlivened by song and dance.

At the evening session E. G. Barrow, C.E., city engineer of Hamilton, read a paper on sewage disposal, which is printed elsewhere in this issue.

In complimenting Mr. Barrow on his instructive paper, President Philip said this was an important subject for Canadian cities and towns, and one that must be studied more seriously by our municipal authorities. Toronto, among other cities, stood in need of reform in its sewage system. There was one question he would like to ask Mr. Barrow, and that was the effect of the filtering operations on the coal used in the filters.

Mr. Barrow replied that after being used for two years in the filters, the coal was found to be as good for burning as before—in fact its burning qualities seemed to be improved, probably owing to the oily matter absorbed during its use. In reply to another question he said any kind of coal could be used, but it must be of small size.

Bro. Moseley asked what was meant by giving the filters a "rest?"

Mr. Barrow said that it meant the exposure of the material to the open air and sun, for an hour or more.

Bro. Geo. Mackie asked as to the relative value of coke or charcoal as a filter medium.

Mr. Barrow replied that they were not considered so efficient as coal. Replying to Bro. Mitchell, he said the sewage to be treated could be made to go up through the filter by pressure or down through it by gravity. The first layers of coal were coarse, and then finer coal was put on down to 1-16 inch. In reply to Bro. McNaughton, he said that in carrying out the irrigation system, it was desirable to make the area of ground broad enough to absorb the sewage without soaking the ground too much. On this account, in some localities, and in wet seasons, it resulted in too much soaking of the soil. The sewage was distributed over the ground by carriers. In the method of underground filtration, the most successful work was done at Berlin, Germany, where the soil was light and porous, and readily absorbed all the sewage. Replying to a question of Bro. Stott, he said that with the lime treatment a disagreeable smell developed, unless the treated material was quickly removed, but it was not so when the material was treated with manganese, which made a better precipitant.

J. M. Williams, of the chemical laboratory of J. Winer & Co., wholesale druggists, Hamilton, then read a paper on "Oils in the Engine-room." This paper will be found elsewhere.

The president, in complimenting the reader of the paper, said it was exactly in line with their work, and although many of them did not pay much attention to the composition of oils, all used them, and should be well posted on their nature.

Bro. Mooring would like a simple test of engine oils.

Mr. Williams said an oil was good, according to the degree of its viscosity, or body, and to test this in a simple way take a can and make a hole large enough to let out a drop at a time. Take a standard oil and count the drops that will come out of this hole per minute, and compare that with the outflow of the oil to be tested. To make the test fair, you must use the same can and the same hole, with the same amount of oil and at the same temperature for both oils. It is still better if two tests are made, one at a high temperature, and one at a low temperature. A viscometer is a desirable apparatus for such tests. As to testing the volatile properties of an oil, this can be done by placing a given quantity in a wide, open vessel and letting it stand a given time to see how much it will lose in bulk by evaporation. The oil that evaporates most is the poorest for lubricating purposes. Coal oil, for instance, which is very volatile, is of no use at all as a lubricant. Neither should an oil be gummy. Heating it in a vessel will disclose whether an oil is gummy, but this trouble will be found chiefly with oils that are derived from fish, or from animals and vegetables, and as most lubricating oils in this country are now of mineral origin, this difficulty is not common.

Bro. George Mackie asked if the volatility of two samples could not be disclosed by placing a drop from each on the cylinder and seeing which dried up the sooner. Mr. Williams replied that such a test was practical and convenient.

The president observed that some oils will run very slowly and yet be of no use on a heavy fast-running journal. He was one of the first who began to use light oils, and though he found the first trials unsatisfactory, one of the representatives of the Standard Oil Co. came around, and, after carefully going into the matter, proved that the difficulty arose, not from the new oil, but from the oils previously used, and after the bearings were cleaned of the former oils, all went well.

Bro. Moseley thought the best test of an oil was the crank-pin of a high-speed engine, running at 270 revolutions per minute.

In reply to Bro. Geo. Mackie, Mr. Williams said that any oil having resinous constituents (that is, of the nature of rosin), adds to the resistance in the bearings and increases the coal bill. In reply to Bro. Mitchell, regarding cylinder oils, he said there was no doubt that wet steam prevented lubrication in the cylinder. If the flash test was low it would be found that the oil, when put into the cylinder, would vaporize, or turn into a sort of steam, and therefore be no good as a lubricant. After discussing a particular experience of Bro. Mitchell, in testing a new cylinder oil, he would say that the flash test should not be too far in advance of the temperature of the steam in the cylinder, at 100 lbs. pressure. In response to a request for tests for oils, together with the usual ones of exposure to high temperatures for volatility, and drying, he suggested to have a bottle marked into thirds and shake together one-third of the oil in question and one-third clear lye (made by dissolving commercial canned lye in water and decanting); after standing mineral oil will rise to the surface, any animal or vegetable oil will be saponified and remain in the lower layer with the lye.

On motion of Bro. Moseley, seconded by Bro. Ryan, a vote of thanks was passed to Mr. Barrow and Mr. Williams for their interesting papers, and for the quiet way in which they had stood the cross-examination of members.

Bro. P. McNaughton then read a paper on "Evaporation and the Raising of Steam in Boilers," which will be found in another part of this issue.

President Philip said this paper disclosed a more than usual amount of study on this subject, and the reader had exhibited the qualities of his race in closely observing the small things in nature which ordinary people would pass over without notice.

On motion of Bro. Mooring, seconded by Bro. Mitchell, a vote of thanks was passed to Bro. McNaughton.

Bro. Chas. Moseley next read a paper on "Economy in the Boiler Room," which will be found elsewhere in this issue, and received a hearty vote of thanks, on motion of Bro. Pettigrew, seconded by Bro. Mackie.

The convention adjourned at 10.30 p.m.

WEDNESDAY, 10TH AUG.

On reassembling at 9.30 a.m., Bro. Dixon brought up the report of the committee on Good of the Order for discussion. With regard to the publication of the bulletin, Bro. Robertson said he had sent a copy, during the preceding four months, to every engineer whose address he could obtain, from Halifax to Vancouver, and where he could not get addresses, he addressed them to the waterworks engineer of the town or village. The question whether they should be sent to the branch associations and distributed to members from the rooms, or be sent direct to the private addresses of members, was discussed, it being the opinion of the majority that it would be better to send it to the houses of members, and each branch should have an address book in which the house addresses should be kept.

On motion of Bro. Geo. Mackie, seconded by Bro. Fox, the whole question of the bulletin was left in the hands of the committee appointed on the previous day.

On the subject of the laxity of branch associations in sending in reports of their meetings and recording their progress generally, Bro. Webb suggested that a printed form of report be sent to the various branches, on which they could report every month, and the Executive Secretary was authorized to prepare such a form.

On the clause of the report relating to the office of secretary, Bro. Dixon moved, seconded by Bro. Chapman, that the Executive Secretary be elected for a term not less than two years. In the discussion it was thought that the association lost much by having a new secretary every year, as by the time one secretary had become proficient in his work, a new man was elected, and the thread was broken. Organizations that had a capable permanent secretary showed better results. The resolution carried.

On the question of the price of stationery supplied to the branch associations, Bro. Robertson stated that the gross receipts of the year from stationery amounted to about $40, and the net profit amounted to about 25 per cent. In view of the smallness of this item it was decided, on motion of Bro. Mackie, seconded by Bro. McNaughton, to allow the present prices for stationery to stand.

The subject of the Bill brought before the Dominion Parliament, for licensing stationary engineers, was then brought up. Bro. Chapman, as one of the delegation sent to Ottawa, reported that along with Bros. Wickens, Mitchell, Ames and Simmons, he had obtained the active help of Mr. Wood, the local member, and the deputation was introduced to the Minister of Justice during the last session. The Minister of Justice showed, by the B.N.A. Act, that the Dominion Parliament had no jurisdiction on this matter, and that it must be brought up in the provincial legislatures. Through the different branch associations about 50 individual members of parliament promised to vote for the Bill, but the opinion of the Minister of Justice blocked the measure, and on the advice of their friends in parliament, it was not introduced into the house.

Bro. Ryan said a number of members of Montreal No. 1 had taken a lively interest in the Bill, and got the Montreal M.P.'s to favor it. Meantime the Bill had been dropped by the Ottawa delegation, who, instead of reporting the result, had allowed Montreal No. 1 to go on working and spending time to no purpose. This was a case of downright negligence, and was the cause of a good deal of annoyance to Montreal members, who should have been informed of the failure of the delegation.

Bros. Mooring, Chapman and Dixon agreed that the deputation to Ottawa were to blame, and should have reported the result of their visit in writing; and Bro. Chapman considered that every engineer in Ontario was to blame for not working harder to secure the passage of a Provincial Engineer's License Bill.

On motion of Bro. Pettigrew, seconded by Bro. Fox, the following were appointed a committee to take up the matter again, and endeavour to secure the passage of the Bill: Bros. Dixon, Allan, Webb, McNaughton and the mover.

An invitation was here received from the Hamilton Literary and Scientific Association to visit their museum on Main street.

The Mileage Committee reported that the total of the mileage allowances paid to delegates was $179.10, leaving a surplus still in the hands of the Executive of about $100.

Bro. Pettigrew was then requested to read the following reply to the address of welcome:

"To his worship, Mayor Colquhoun and Aldermen Carscallen and Nelligan: Gentlemen—We, as a body of engineers, extend to you our hearty appreciation of your cordial and kindly address of welcome to your pleasant and prosperous city, at our ninth annual convention. We, as a body of working men, do not believe in the furtherance of strikes or labor trouble of any kind. We are organized for educational purposes, in order that our employers may be benefited thereby, and thus ensure for them efficiency, carefulness and stability to reduce operating expenses generally. It is our aim to advance the interests of those by whom we are employed. It may be interesting for you to know that there are members of this association who are worth 100 per cent. more to their employers to-day than they were ten years ago, thus showing that their admission to the society was to their benefit as well as to their employer's. It is not our intention to laud our society as being the best on earth in regard to benefits, such as insurance, sick benefits, etc., but we do maintain that our society is the best organized for the advancement of its members in their calling. We are pleased to meet in your beautiful city, and trust that our meeting here may be beneficial to you and the manufacturer and steam user, as well as to ourselves, and hope that we may meet here again some time in the future. We wish to thank you for the hearty reception you have accorded us, and we assure you that we feel entirely at home here. We shall endeavor to conduct our business in the best manner possible, and trust our deliberations may be profitable to one and all. Again thanking you for your kind and enthusiastic greeting, we are yours respectfully, Thomas Ryan, Montreal; A. M. Wickens, Toronto; W. G. Blackgrove, Toronto."

Bro. McNaughton wished to ask the president what was meant by a "member in good standing."

The president replied that it was a member who was not six months or more in arrears with his dues.

Bro. Webb said that branch associations, by paying capitation tax on its delinquent members, obtained representation at the conventions to which they were not really entitled.

Bro. Mooring said this was a burning question in Toronto, and there ought to be some uniform policy adhered to in this matter.

The president said the real trouble was that the branch associations did not take off their books members who fell in arrears without special cause.

Bro. Webb said that in Ontario all associations were under the Ontario Assessment Association Act, and must give a member due notice of his suspension. In the case of Toronto, a good many members had been notified of their arrears time and time again. Members in arrears for one term before the convention have from the second meeting in June until the end of the month as a last chance. This was sufficient opportunity, and there ought to be no representation here from dead members.

Bro. Ryan said that in Montreal no member in arrears was carried on the books of the association unless he could show cause for non-payment.

On motion of Bro. McNaughton, seconded by Bro. Allan,

it was resolved that the local secretaries be instructed to enforce the by-law regarding members in arrears.

A question arose as to the numbering of the recently formed Toronto association, and Secretary Robertson said it was entered as "Toronto No. 2," at the request of the association itself. It was pointed out by some members that another branch being already known as No. 2, this would lead to confusion.

Bro. Geo. Mackie moved, seconded by Bro. McNaughton, that when the present stationery ran out, the name of Toronto No. 2 be changed to No. 18. Carried.

Bro. Dixon thought that locally the new Toronto branch could still be known as No. 2, and the No. 18 could be used in convention matters.

The convention then adjourned till afternoon, when Bros. Dixon, Asselstine, and Grundy were appointed scrutineers for the election of officers. The election resulted as follows, the first three being returned by acclamation:

President, W. F. Chapman, Brockville.
Vice-president, R. C. Pettigrew, Hamilton.
Secretary, J. G. Robertson, Montreal.
Treasurer, G. C. Mooring, Toronto.
Conductor, Wm. Bear, Dresden.
Doorkeeper, John L. Wendell, Waterloo.

Bro. Robertson moved, seconded by Bro. Dixon, that the next annual convention be held at Berlin.

Bro. Fox moved, seconded by Bro. Bain, that the next convention be held at Toronto.

Upon a show of hands the question was decided in favor of Berlin.

The installation of the new officers then took place, Bro. Ryan being appointed installing officer.

In the absence of the Mayor, Judge Snider performed the ceremony of pinning the past president's jewel on the breast of the past president, remarking as he did so, that he had heard of past president Philip's intelligence and uprightness in the discharge of his high office, and it gave him, therefore, especial pleasure in being the medium of presenting the jewel. Bro. Philip replied in suitable terms. The work of the officers was carried on under difficulties, and the only way to make it a success was for each one to do what lay in his power.

Bro. Ryan was then asked to present himself before Judge Snider, and was evidently surprised at the request. He was still more surprised when a past president's jewel was taken out of a case and pinned on his breast. Judge Snider assured Bro. Ryan that this token expressed the feeling of reverence and esteem in which the association held him for his past efficient services.

Bro. Ryan said he could hardly tell how surprised he was at this manifestation of good-will, and he could only say just now that he would persevere in his efforts to promote the good of the association.

On motion of Bro. Dixon, seconded by Bro. Mackie, a vote of thanks was passed to Judge Snider for his kindness in attending at this function; and a similar vote to Bro. Ryan for the way in which he had fulfilled his duties as installing officer.

On motion of Bro. Mooring, seconded by Bro. Mackie, a gratuity of $25 was presented to Bro. Robertson for his efficient services as secretary.

The price of the new handbook was fixed at 25 cents to members, and 50 cents to outsiders.

On motion of Bro. Dixon, seconded by Bro. Philip, a vote of thanks was passed to THE CANADIAN ENGINEER for its report of the convention, and the interest it had taken in the progress of the association.

Bro. Wickens, who now arrived, being asked as to the license bill, said a circular had been sent to all members explaining the proposed Bill and soliciting their support. About 50 promises were received, but when the deputation went before the Minister of Justice, he held that under the B.N.A. Act, the Dominion Parliament had no jurisdiction. The Marine Engineers were brought under license from the Federal Government, because they were a part of the machinery of the trade and commerce of the country, over which it had jurisdiction, but it was not so with Stationary Engineers. Hence the Minister argued that the Provincial Government only had the right to pass such a law. The Ontario Association of Stationary Engineers had put up the expenses of the deputation, to the extent of $200, and they had appropriated $150 more for prosecuting the measure in the Ontario House.

After some discussion it was decided that the committee of this association should co-operate with the committee of the Ontario Association of Stationary Engineers, with a view to obtaining the necessary legislation.

On motion of Bro. Philip, seconded by Bro. Fox, a hearty vote of thanks was passed to Hamilton No. 2, for its hospitality and the pains it had taken to make the convention a success. Bro. Ironside said that it would afford him pleasure to convey the resolution to his association.

On motion of Bro. Ryan, seconded by Bro. Fox, it was decided that the expenses of the hall be paid for out of the funds of the Executive.

After a vote of thanks to the city press, the convention closed, and the delegates went on a trip of observation around the city, visiting the new sewage disposal works (described in THE CANADIAN ENGINEER of Jan., 1897), where they were shown the various processes by Bro. Robt Mackie, the engineer in charge; and visiting also the Victoria Yacht Club's establishment, the House of Refuge and the Street Railway power house. The delegates were presented at the City Hall with a copy of the handsomely printed "Souvenir of Hamilton," and in the evening they were the guests of the Hamilton Street Railway Co., in a ride about the city on a special car.

THE BANQUET.

The proceedings of the convention were brought to a close by a very successful banquet, given in the large dining-room of the Waldorf. This was the maiden dinner in the new hotel, and the impression made by the management was certainly very favorable. Over 100 guests sat down to the dinner, which was presided over by Robt. Mackie, president of the Hamilton branch, who made an excellent chairman. He was assisted by the following members of the Hamilton branch, who acted as dinner committee: J. Ironside, secretary; W. R. Cornish, W. Stevens, R. E. Chilman, Thos. Chubb, and Geo. Mackie.

After reading letters of regret from Mayor Colquhoun and others, who were prevented from attending, the toast list was taken up. The "Queen" was followed by "Canada our Home," to which Stuart Livingstone responded, referring to the romantic and stirring incidents that abounded in the three and a half centuries of Canadian history. He gave a glowing eulogy of the U. E. Loyalists, those heroes and heroines who left all to maintain their allegiance to the empire, who, having no houses, no villages, no post offices, no railways or telegraphs, and no newspapers to record the story of their wrongs, followed the northern star, and worked out their destiny in pain and trial, but with a never faltering loyalty. It was the thought of what these loyalists had done for Canada that nerved us to the struggle of 1812, and had inspired us to every high national endeavor since; and there was no man here who could not be thrilled with the story of brave Laura Secord, who threaded her way 20 miles through the dense woods to warn Lieut. Fitzgibbon, and enable him to capture a force of Americans of ten times his own. The speaker referred to the many Canadians who had achieved fame abroad—in India, Egypt, and other remote lands—and to the vast opportunities there were for great achievements in our own wide domains, which our fathers won by right of purchase, but which we have by right of birth. "The Mayor and Corporation" was replied to by Ald. Nelligan, and ex-Mayor Blaicher. The former regretted the absence of the Mayor, who was in Toronto attending his duties as member of the legislature. His statement that a copy of the "Souvenir of Hamilton" was being presented to each delegate was received with cheers. He concluded by hoping that in the near future the convention would come back to Hamilton. Ex-Mayor Blaicher was pleased that the convention had received a hearty welcome, and he commended them for their principle of non-interference in strikes, which had done a great deal of harm to Hamilton in days gone by. He was proud of the scenic beauties of Hamilton, and its neighboring country, so famed for its orchards and vineyards, and was equally proud of the fact that the manufactures of Hamilton now commanded the confidence of the whole Dominion, while some of its products were known and esteemed in foreign countries. "The Manufacturers" was responded to by ex-Ald. A. H. McKeown and J. H. Clappison,

of the Clappison Pipe and Boiler Covering Co Mr. McKeown said the manufacturers of Hamilton had confidence in this association, knowing that if they employed a member, they were sure to have an efficient engineer, and generally a trustworthy man. The manufacturers recognize that in this way the association has been a great benefit to themselves. Mr. Clappison expressed the pleasure it gave him to reply to this toast. Being a manufacturer himself, he was proud to realize the truth of the statement already made that Hamilton now took a leading part in the industrial development of this country. The quality of Hamilton's special manufactures was constantly rising in the estimation of the people. He was glad that the delegates were going away pleased with their reception, and he hoped when the next convention was held here, that they would come in three times their present numbers. The toast of "Educational Interests" was coupled with the name of W. H. Ballard, public school inspector; J. M. Williams and Percy Domville. Mr. Ballard said if citizens of Hamilton were proud of their advance in educational matters, they owed it to themselves. The school attendance in the city had increased 70 per cent. in the last 13 years, and the general work of the schools had doubled in the last 10 years. Over $250,000 was now invested in school property. Mr. Williams referred to the pleasure he took in being with the association, as while he may have taught them some things he had also learned from them. Mr. Domville, in his speech, advised steam engineers to learn something about electricity, which was creeping into so many lines of manufacture. In a few days they would have the electric current, generated 30 miles away, turning wheels in Hamilton. Some went so far as to say that electricity would do away with steam altogether, but he did not think this would come to pass, as there were plants that could be run more cheaply by steam even when the electric current was brought into Hamilton. "The Executive Head" was responded to by past-president E. J. Philip, who was glad to say that the Executive was in better shape this year than for some years past, and he hoped it would be in still better shape next year. He was always glad to come to Hamilton, for he thought very highly of the city and its citizens. President W. F. Chapman followed, expressing his pleasure at meeting the people and the engineers of Hamilton, who should be proud of their beautiful city. As president of the association, he hoped to follow in the footsteps of their popular past-president. Secretary J. G. Robertson and treasurer G. C. Mooring also replied, complimenting the Hamilton branch on the good work it had done. Telegrams were read from Albert E. Edkins, of Toronto, and John J. York, of Montreal, both past presidents, conveying their felicitations to the assembled guests. "Sister Associations" was responded to by J. M. Wickens, representing the Ontario Association of Stationary Engineers. He referred to the new Cataract Power Co.'s works, and pointed out that through the work of the C.A.S.E., there were plants in this city that had got the cost of steam down to such a point that the new electric power company could not displace it. Another thing the C.A.S.E. had accomplished was the institution of technical branches in the high schools of Ontario; while the establishment of the Toronto Technical School, which had shown such excellent results, was also due to it. "The Press" was replied to by E. B. Biggar, of THE CANADIAN ENGINEER, and by Messrs. Reid and Kirkpatrick, of the Spectator and Times. "The Ladies" were championed by Thomas Ryan, Montreal, J. M. Dixon, Toronto, and P. McNaughton, Montreal, and while all three spoke extremely well, it was admitted that Mr. Dixon's was the speech of the evening, and he came off with honors, both as an orator and entertainer. "The Host and Hostess" concluded the toast list, and the company broke up about 2 a.m. The musical part of the programme was well rendered by James Jardine, Geo. Allan, E. T. Martin, W. W. Barlow, J. Grant, and J. M. Dixon, B. Arthur being accompanist.

W. F. Chapman, president of the Canadian Association of Stationary Engineers, was born at Gananoque, Ont., and was in business for some time with his father, John Chapman, who operated a cheese and cheese box factory there. He picked up a knowledge of engineering in his father's factory, and having studied electricity, gained enough knowledge of that business to instal the electric plant for Cooke Bros. at Lachute. After running this plant for some time he installed a plant at the Taylor & Walton Carriage Co.'s Works, this company being also owners of the Gananoque Electric Light and Water Supply Company. He then went to Brockville, and was appointed

W. F. CHAPMAN, PRESIDENT, C. A. S. E.

engineer of the Canada Carriage Company, which position he has filled till the present time. That Mr. Chapman has the esteem and respect of his fellow engineers is evident by his appointment to the highest honor in the association.

R. C. PETTIGREW, VICE-PRESIDENT, C. A. S. E.

A biographical sketch of Robert C. Pettigrew, who has been elected vice-president of the C. A. S. E., has already appeared in The Canadian Engineer. Mr. Pettigrew, who is in business as a coal merchant in Hamilton, has not only been a generous helper in all that concerns the progress of the C. A. S. E., but has for many years taken a lively interest in the municipal affairs of Hamilton. He was for three years on the School Board, and is now an alderman, representing Ward No. 7, having been returned at the top of the poll.

G. C. MOORING, EXECUTIVE TREASURER, C. A. S. E.

G. C. Mooring, executive treasurer of the C. A. S. E., was born at Evenly, Northampton, England, and came to Canada in 1874, when he obtained employment with Thompson & Williams, of Stratford, as machinist. Having learned the business there, he came to Toronto in 1878 working successively at the

Toronto Reaper & Mower Works, the Massey Company's Works, the Toronto Bridge Works and the Standard Woolen Mills. For the last nine years he has been in the employ of the Methodist Book Room, as engineer of their large printing and binding establishment. His father was also an engineer.

J. G. Robertson, executive secretary of the C. A. S. E., was born in St. Johns, Que., and on reaching the age at which he felt able to make his own way in the world, went to Chicago and apprenticed himself to Crane Bros., the large valve makers of that city. After living in the United States in various cities, as machinist, for about 17 years, he returned to Canada about twelve years ago and settled in Montreal. He was appointed engineer of the Montreal General Hospital, a position he has ably filled ever since.

WM. BEAR, CONDUCTOR, C. A. S. E.

William Bear, conductor of the C. A. S. E., is a native of the State of New York, but came to Canada at the early age of 3 years, and may therefore be considered a Canadian. Mr. Bear has been fourteen years an engineer, all of which time he has served in Dresden, where he is now chief engineer of O. & W. McVeane's spoke and hub works.

JOHN L. WENDELL, DOORKEEPER, C. A. S. E.

John L. Wendell, doorkeeper of the C. A. S. E., is a native of the thriving town of Waterloo, Ont., and represented the Waterloo branch of the C. A. S. E. at this year's convention. Mr. Wendell has been about six years an engineer, and is now assistant engineer at Seagram's large distillery in Waterloo.

Thomas Ryan, engineer of the Federal Government buildings, Montreal, who was presented with the past president's jewel at the Hamilton convention of the C. A. S. E., was born in Quebec 62 years ago, and his father and mother before him were both born in the same city. Mr. Ryan served his apprenticeship as a machinist in the shops of Calvert & Tweedall, of Quebec, and after serving his time obtained his first engagement as engineer on the steamer "Blue Bonnet," running from Montreal to Cornwall. He was then less than 20 years of age and was the youngest engineer of his time on any large Canadian boat. After having charge of the engine at the dry dock works of Millin & Milne, Montreal, he was appointed engineer of a dredge under the Public Works Department. After remaining there several years, he was taken into the service of the Ottawa River Navigation Company as engineer of the steamer "Prince of Wales." After remaining with that company for 16 years he entered the service of the Quebec, Montreal & Ottawa Railway Co., now a part of the C. P. R. system. For the past 16 years he has had charge of all Federal Government buildings in Montreal, which responsible position he

THOS. RYAN, PAST-PRESIDENT, C. A. S. E.

has filled with eminent ability. His ripe experience, good judgment and sound practical engineering knowledge have won the confidence of each successive Government. While Mr. Wickens is looked on as the founder of the Toronto branch of the C. A. S. E., Mr. Ryan may be called the father of the organization in Canada, having formed the pioneer association in Montreal about 1883. He, with George Hunt and Harry Wilson are, so far as known, the only members of the original association still remaining. In response to a circular issued by Mr. Ryan, about a dozen engineers gathered in the old Sunderland House, St. Lambert's Hill, in the year mentioned, and there formed the first Association of Stationary Engineers, the constitution being based largely on the National Association of Stationary Engineers of the United States. Mr. Ryan also took part in founding the first association of engineers for the benefit of French Canadians, who from lack of knowledge of the English language, were unable to reap the full benefit of the English Association. Mr. Ryan is a prominent member of St. George's Lodge, No. 10, A. F. & A. M., and is a past officer of the Grand Lodge of Quebec.

ANSWERS TO CORRESPONDENTS.

A. W. E., Lennoxville.—We have advised you privately as to the makers of acetylene lamps.—Ed. Can. Eng.

G.—In answer to your question about the fairness of the specifications upon which tenders were called for an electric lighting plant, it appears to us that the specifications of an individual make of apparatus, as the lamp for example, would naturally shut out from tendering the makers of rival appliances —Ed. Can. Eng.

MECHANICAL STOKER TEST.

The General Engineering Co., of Toronto, Ltd., successors to the Weeks-Eldred Co., are installing six of the Jones Underfeed Mechanical Stokers in the mills of the Laurentides Pulp Co., of Grand Mere, Que.; twelve in the pulp mills of the Maritime Sulphite Fibre Co., of Chatham, N. B.; twelve in the power house of the Toronto Railway Co.; two in the new C. P. R. station at Dalhousie Square, Montreal, and a second order for the Windsor Hotel, Montreal.

A commercial test was made recently on two boilers at the power house of the Toronto Railway Co., for the purpose of determining the saving in fuel effected by the Jones Underfeed Mechanical Stoker. The boilers tested were of the cylindrical, return-tubular, internally fired type, 9 feet 9 inches diameter by 14 feet long, each boiler having two corrugated flues 39 inches inside diameter and 80 tubes 4 inches diameter, 14 feet long. The report of the test published by the company shows a saving in fuel effected by the stoker for equal evaporation of 15.2 per cent., and increased evaporation for equal fuel equal to 17.93 per cent.

THE LATE SIR CASIMIR GZOWSKI.

SIR CASIMIR GZOWSKI.

Col. Sir Casimir Gzowski, A. D. C. to the Queen, died at his residence, "The Hall," Bathurst street, Toronto, Aug. 24th.

Casimir Stanislaus Gzowski was descended from an ancient Polish family, who in the 16th century were ennobled, and who for a period of 200 years after their elevation continued to exercise great political influence in Poland. The father of Col. Gzowski was known in Poland as Stanislaus, Count Gzowski, and held a commission in the Russian National Guard. Sir Casimir was born in St. Petersburg, Russia, in 1813. At a very early age he entered the military college at Kremenetz, Province of Volhynia, where he pursued a course of military engineering, and in 1830, having been in the college eight years, he graduated as an engineer, and was awarded a commission in the Russian army. It was at the time of his first entering the Imperial army that one of the periodical insurrections occurred arising from the discontent of the Polish people at the severe treatment of Constantine, brother of Emperor Nicholas, who was made military governor of Poland. An organized revolution finally broke out, in which most of the Polish officers in the Imperial army joined. This revolution culminated in the expulsion of Constantine, who, with his court and Russian adherents, were driven from Warsaw. Young Gzowski, who had just received his commission at the time of the first outbreak of the insurrection, immediately joined his compatriots, and played a conspicuous part throughout the insurrection, and was present in Warsaw in November, 1830, when the Grand Duke Constantine was expelled.

As is well known, Russia and Austria, after bloody conflicts, lent their assistance to quell the insurrection, and Warsaw was recaptured from the Poles by the allied forces under Count Paskevitch in 1831. The prisoners taken at Warsaw on its fall were either condemned to die or to linger in the mines of Siberia. After the battle of Baremel, Gen. Devernicki's division, to which Gzowski was attached, retreated to Austrian territory, and the division surrendered. All but the officers were allowed to go wherever they pleased, but the officers were condemned to military prisons for some months, when an arrangement was entered into between Austria and Russia, and the whole of them were shipped to the United States, Colonel Gzowski among them. Colonel Gzowski landed with his fellow exiles in the United States without a penny. He found that owing to his lack of knowledge of English his engineering skill would not be very remunerative, so he set to work to learn the language, and for a time taught French and German in New York. Subsequently he articled himself to Parker L. Hall, a lawyer of Pittsfield, Mass., and studied law. During these studies he maintained himself by giving lessons in modern languages, drawing, and fencing, in the local academies. In 1837 he began the practise of law in Beaver county, Pa., and remained there until 1841. From 1841 to 1846 Mr. Gzowski was employed in the Public Works Department of the Canadian Government. In private practice after leaving the employ of the Government, the first great enterprise with which Mr. Gzowski was connected was the St. Lawrence and Atlantic Railway Company, from Montreal to Island Pond. He was appointed chief engineer, and was practically engaged on the construction of this railway. This appointment he resigned when the railway became merged in the Grand Trunk Railway. Subsequently a partnership was formed, the firm consisting of Sir Alexander Galt; the late Luther H. Holton; the Hon. D. L. Macpherson, and C. S. Gzowski. This firm on the 24th of March, 1853, obtained the contract for the construction of a line of railway from Toronto to Sarnia. The work was attended with enormous profit, and was satisfactorily completed. Among other railway works completed by the firm of Gzowski & Macpherson is the line from Port Huron to Detroit, and from London to St. Mary's, in the Province of Ontario. One of the most noteworthy and successful feats of engineering performed by the firm of Gzowski & Macpherson was the building of the International bridge over the Niagara river, at Buffalo. The charters for the construction of this bridge were granted by the Legislature of Canada and State of New York in 1857. The funds for its completion were raised in England in 1870, and the bridge was completed November 3, 1873, the cost of construction amounting to over $1,500,000. He was the chairman of the Queen Victoria Niagara Falls Park Commission.

Sir Casimir was connected with many financial concerns during his long career. He was at various times president of the Toronto Club, for some years president of the London and Canada Loan and Savings Company, president of the corporation of Wycliffe College, and vice-president of the Ontario Bank. He was appointed lieutenant-colonel of the Central Division of Volunteers in Toronto, in 1873. His last and highest promotion was that of full colonel, and in May, 1879, he was appointed aide-de-camp to her Majesty Queen Victoria, being knighted K. C. M. G. a year later.

F. NAPIER DENISON.

F. Napier Denison was educated at Upper Canada College and entered the Toronto observatory, but finding promotion slow, went to Boston and studied electrical engineering. After obtaining a certificate he traveled for six months throughout the United States as electrical expert for the Thomson-Houston Electrical Company. In 1891 he came to Canada and joined the Excelsior Company. During 1892 he spent six months traveling throughout the various countries of Europe, where he obtained much valuable electrical information as well as attending special

F. NAPIER DENISON.

lectures in London. During 1893 he perfected his electric dental engine, which has been patented in many countries, and is being successfully manufactured in Canada, not only for a large home, but also British, trade. This was followed by many others (all patented), including an electric transmitting thermometer, an electric brake, a new grain bin and heat detector, a combined shaving brush and soap holder for travelers. After re-entering the meteorological service in 1895 he devoted his inventive ability to the benefit of this service, and has devised an electric anemograph or automatic instrument to record both the direction and velocity of the wind, a simple form of "hydrograph," set up at the mouth of the Humber River to record the lake undulation; and as it was thought these undulations were due to atmospheric waves, he devised a self-recording barometer seventeen times as sensitive as the ordinary mercurial type.

which was set up at the Toronto observatory. By studying corresponding records from both instruments, the direct action of atmospheric waves as causing the water undulations was clearly shown. In July, 1897, Mr. Denison devised a combined instrument to record both lake and atmospheric undulations upon the same time cylinder, and set it up in place of the former instrument. This device, which has been termed a "hydro-aerograph," was fully described in a paper read before the Toronto meeting of the British association last year by the inventor, a reprint of which appeared in the October and November numbers of this paper. Last May Mr. Denison constructed for the Public Works Department, Ottawa, another form of hydrograph, which has been set up at the Queen's wharf, Toronto. Mr. Denison has left Toronto for Victoria, where he is to start weather forecasting for the Province of British Columbia, issued in the same manner as those from the central office, Toronto. A sensitive hydro-aerograph is to be installed there, as it is hoped the records from some will tend to assist in warning the approach of storms, which sweep in off the Pacific Ocean.

FIRES FOR THE MONTH.

Aug. 3rd The Canadian Rolling Mills, Peck, Benny & Co., Montreal; damages amounted to $75,000; insurance, $152,000. ——Aug. 4th. J. & B. Grier, saw mill, Montreal; loss about $10,000.——Aug. 4th. St. Lawrence Portland Cement Co., Montreal; premises destroyed; loss, $20,000; small insurance.——Aug. 5th. Devine Bros., Killaloe Station, Ont., planing mill; loss, $1,000.——Aug. 9th. Victoria, B. C., Chemical Works; partially destroyed; loss about $20,000; fully insured. ——Aug. 13th. Jenckes Machine Co., Sherbrooke, Que.; damaged to a considerable extent but covered by insurance; business has not been interrupted materially.——Aug. 14th. M. Bristol's wood-working factory, Madoc, Ont.; loss, $10,000; insurance, $1,000.——Aug. 14th. Biette & Co.'s saw mill and cheese-box factory, Chesley, Ont.; loss, $8,000; insurance, $1,000.——Aug. 14th. Miller Bros.' paper mills, Glen Miller, Ont.; damaged to extent of $17,000; covered by insurance.——Aug. 22nd. Steamer "Golden City" burned at her docks, Lakefield, Ont.; loss, $5,000; some insurance.——Aug. 26th. J. H. Still's handle factory and unused pipe foundry adjoining, St. Thomas, Ont.; loss, $50,000 on the handle factory, and $10,000 on the foundry. ——Aug. 28th. The Parmenter & Bullock Co.'s rivet and nail works, Gananoque, Ont.; loss, $30,000; insurance, $12,000.—— Aug. 30th. Some damage was done to the power-house of the London (Ont.), General Electric Co., amounting to about $1,000.——Sept. 1st. Bertram Engine Works Co.'s shipyard, Toronto, damaged to extent of $60,000; fully covered by insurance.

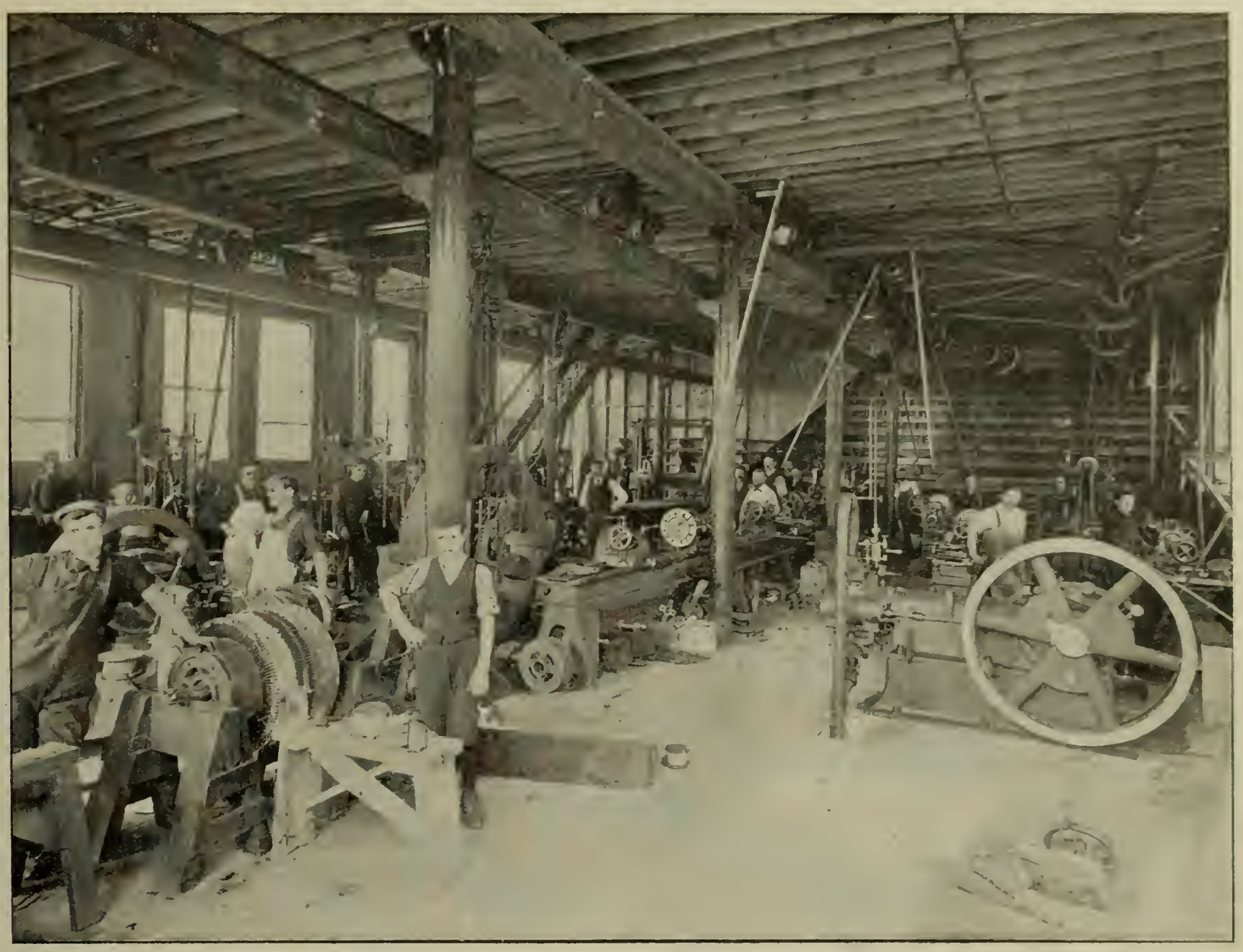
THE TORONTO ELECTRIC MOTOR COMPANY, LTD.

In this issue we present a cut of The Toronto Electric Company's new factory recently completed and now occupied by this thriving manufacturing concern, which started business some six years ago, and which has steadily increased year by year, until now it is one of the leading firms in Canada in the manufacture of the electric machinery and apparatus for lighting and development of power in all its branches. Beginning with electric motors in a comparatively small way the company has added new lines from time to time as demands required, such as belted C. P. dynamos and direct connected generators for lighting and power service in all standard sizes up to 300 k.w.

In March this year this company amalgamated with the Thompson Electric Company, Hamilton, Ont., thus adding that firm's well-known system of automatic arc lighting dynamos and their several types of arc lamps for constant potential, constant current and alternating current circuits, together with all their machinery and special tools for manufacturing. This company's new works are of the most modern and improved type for the class of work upon which it is engaged. The machine shop is supplied with the latest improved machinery and tools, classified and divided into sections, to best suit the convenience in handling the different classes of work; each section being operated by an independent electric motor. The centre of the shop is provided with a 16-ton traveling crane, for its entire length. The arc lamp department is on the second floor, and is supplied with light machinery and special tools and jigs for turning out accurate and standard work. Then comes

the winding room, which is also a separate department, and supplied with necessary lathes, forms, bucks and special appliances for this particular class of work. In the basement is situated the brass moulding department and steam plant, which operates a direct connected unit that supplies current for the power and lighting of the entire works.

The company is now working its factory overtime to meet the demand for its apparatus. Some of the principal orders now being turned out are: Direct connected generators for the T. Eaton Company; complete electric plant for the Verity Plow Company, Brantford, Ont., including a direct connected generator; two incandescent dynamos for the Parkhill Electric Light Company; two 60-light arc dynamos and 80 arc lamps for the Brantford Electric & Operating Company; electric power and lighting plant for the Rat Portage Lumber Company; two 40-h.p. motors for The Mail and Empire Company; 100 arc lamps for the Lachine Rapids Hydraulic & Land Company, Montreal, and numerous smaller orders. Owing to the pressure of business this company will not exhibit at the Toronto Industrial Exhibition this year. Any visitor that will favor the company with a call at the new works, 39 to 45 Pearl street, will be warmly welcomed.



TORONTO ELECTRIC MOTOR CO.'S MACHINE SHOP.

AN UNSANITARY DISCOVERY.

BY W. M. WATSON.

Tourists spending their holidays in Muskoka and other Ontario summer resorts have been considerably exercised on account of offensive odors that have, during the present excursion season, pervaded those districts. We have it on unquestionable authority that large gatherings have abruptly dispersed on account of a sudden passage through the air of a disgusting odor, and which has been stated to be caused by a pest named a stink bug. In the early days of my residence in Canada I was a thorough unbeliever in the power of the animal called a skunk to create a nuisance, but in time proofs came to hand and I was convinced. But not so with the theory put forth to explain the odors that have occasionally contaminated the air, and entered the interior of several of the hotel rooms; before such statements can be taken for granted, at least one of the pests must be caught and produced. I have been engaged to try to give a reliable reason for the foul odors that seem to come, sometimes rather suddenly in the evenings at one of the hotels, and after about 30 minutes time (often less), it completely passes away. It seems only to come after sunset and seldom after the hours of midnight. This almost proves that the cause of the odor either moves in the atmosphere like a bird or the odor is in such large quantities that it moves through the atmosphere in a column, leaving the odor in any place or in any room that it may come in contact with during its passage

From the information I have gathered I find that there are hotels in that district whose sanitary conditions could be improved, and others that have secured the city advantages of a plentiful supply of good water and almost every modern sanitary appliance necessary for the cleanliness and comfort of their patrons, erected with great care, and high class workmanship. It is one of the last named kind that I was called upon to inspect and try to locate the cause of the occasional unpleasant odors. I was the third party that had been called in for the purpose. Each of the previous firms had thoroughly examined and tested the plumbing appliances and drains, and I believe found them smoke-proof and perfect. This hotel had a private sewage disposal works, that seemed to get all the blame, from the managers and attendants. The settling tank was 100 yards from the house, and well covered up, with an air-tight wooden cover, and sand. It had a breather pipe about one foot high and a 4 inch air discharging pipe, 20 feet high, and on account of a suspicion that the foul gases from the tank were discharged into the air through the two pipes, and traveled into the rooms of the house, they had been plugged tight up, but the smell still continued to come as usual. Then the irrigation gravel sewage filter was over another 100 yards away, situated behind a bend and cliff of land, which had also two tall air vent pipes, which would discharge foul air that might travel to the hotel, but it appeared to me rather improbable.

The boarding accommodation for tourists is erected on low grounds near the sheets of water, and this one had high hills on

two sides acting as a boundary line and shield of the narrow strip of water and foreshore situated between them. The sun during the day heated the surface of the land and the walls of the building, the roofs, and to a certain extent, the face of the water. At sunset the atmosphere cooled quicker than the earth, the walls and roof of the building or the face of the sheet of water. This would cause a depression of the atmosphere, making the upper strata of the air descend and cool the warm places, having the effect of reducing the draughts of chimneys, air and soil pipes, and would also let free and distribute any confined gases that might be accumulated in the sanitary apparatus or foul spots near the dwelling. This depression cannot be avoided, therefore it is the duty of plumbers and sanitarians to so erect and put together sanitary appliances in a way that it is absolutely impossible for poisonous gases to generate, and this can be easily done by using reasonable judgment in arranging the soil pipes, the waste water pipes, and the system of drainage.

In another article which I had written before going to inspect this place, and which is published in another part of this paper, entitled "Sanitary excesses," I have described what is needed to aerate soil and waste pipes. In April, 1897, this paper published an article of mine on sanitary appliances, which also explains how to make sanitary waste and soil pipes safe, and what is particularly necessary to be adopted in summer hotels to prevent gases and foul smells from generating in hot weather. On this account these points need not be repeated here.

The hotel of which I am writing has three separate and distinct stacks of soil pipes and sanitary apparatus in each of the three wings of the house. All the soil pipes are joined together and connected with the main trunk drain at one point. The small waste pipes from the baths, the basins, the slop sinks, and even the drinking fountains placed in the corridors of the house, are I believe each and all connected directly with the nearest line of soil pipes, and on this account none of the pipes can secure the proper amount of aeration necessary to prevent the generation of poisonous gases, and when poisonous gases are created they will in spite of every endeavor made to prevent them, escape and contaminate the atmosphere. This statement was fully proved by the exhaustive experiments made by the city of Cologne, see report on page 62 of the July issue of The Canadian Engineer. Now it is easy to fix a first-class sanitary water closet that cannot possibly require a vent or back air pipe. And experiments prove that back air pipes obstruct soil pipe ventilation, and prevent the ventilation which is necessary to keep the interior of the waste pipes clean and properly purified. No small waste pipes serving water fountains, pipes from ice boxes, underground land tiles, or from small baths, wash basins, wash tubs or slop sinks should ever be connected directly to soil pipes or drains, because the small 1½ inch traps are easily dried out by evaporation in hot weather, and all the sooner when a back air pipe is attached, and if they happen to be dried out when a depression of the atmosphere occurs, then the foul gases will enter the rooms in large quantities. And each and all small waste pipes and fittings can be served and made absolutely safe by an easier and cheaper method. Moreover when there is a decided depression of the atmosphere, the vent pipes cannot prevent the water seals in the small traps from oscillation, and when the water in the seals oscillates it usually wastes a portion of the water over the bends, and of course the seal is broken and a passage of air created. It is just possible that the foul odors that invade the apartments immediately after sunset may be accounted for in this way, but it can be proved only by having the smoke machine attached ready and applied at once, when the foul odor is first apparent.

The plumbing of a large summer hotel requiring several sets of apparatus and stacks of soil pipes cannot be made sanitary by exactly the same methods as a place with only one set of appliances, and soil pipe, and they require much more skill and judgment to insure a thorough upward draught and free ventilation through every waste pipe, which is necessary, to remove any risk of down draught currents.

The contract for the seating of Her Majesty's theatre, Guy street, Montreal, has been awarded to the Canadian Office and School Furniture Co., Preston, Ont.

ECONOMY IN THE BOILER ROOM.*

BY CHAS. MOSELEY, ENGINEER, TORONTO INCANDESCENT LIGHT CO.

The fuel expense is one of the largest in the operation of the majority of plants, and any reduction which can be made in the amount of fuel used, while maintaining the same amount of power, is considered a direct gain. The evaporation of more than nine pounds of water per pound of coal is looked upon with suspicion by many, as it is not thought possible to obtain more than this amount in even the best designed and well regulated furnaces and boilers, especially when the firing is done by hand. Mechanically fed boiler furnaces usually give the most economical results. The actual value of the fuel depends upon the way in which it is used fully as much as on any other factor. The heat unit in the coal should be as much as possible utilized, as in one pound of good steam coal there is about 14,000 B.T.U., and about 10,000 of this amount can be utilized, so that 4,000 heat units are lost. The mixture of gases in a furnace depends on the amount of air used. One pound of coal requires theoretically about twelve pounds of air to burn completely. But in practice about twice this amount is required in the boiler furnace. To cause good combustion coal requires a good draft. The gases are consumed near the fire, and the waste gases carry the heat to the boiler on their way to the stack. The boiler ought to have sufficient heating surface, or the hot wasted gases ought to travel a sufficient distance to be cooled down to about 350° F., which temperature is found high enough to produce a good draft in a stack of at least 100 feet high. It is not necessary for me to state the need of keeping the combustion chambers free from the ash that is carried over with the gases to the chambers. In "Smokeless Heating," as published by the General Engineering Co., there is a paragraph entitled, "Competitive vs. Ordinary Test," which is well worth consideration, and I think we might study it with profit. In nearly all plants where a large quantity of coal is burned per day it is a general rule to employ the least possible number of firemen, and it keeps them very busy going from one boiler to the other shoveling in coal the whole time. It becomes more of the nature of slavery than anything else. Is there economy in this way of working? Let us see. In making evaporation tests my experience has been that there is a large difference between ordinary working and working for short spells, as in making competitive tests. When we were making the tests in our plant, while experimenting with shaking grates, the Hawley Down Draft, and the Jones Underfeed, we did so in many different ways. With the Hawley Down Draft in one particular case we fired that boiler as would have to be done in ordinary practice, and the result was certainly a far different one from that obtained when the man stood by this furnace, and attended to it alone. If we treat the fireman as being a naturally lazy animal, I think we will be on the safe side, and you can rest assured that if he has one boiler that will do the same work as another with half the labor, even though the other takes less coal, this boiler will get the most work, and the boiler that should receive constant attention will get very little consideration from him. Between competitive and ordinary working on a hand fired boiler there is actually a difference of 10 per cent. This I have proved repeatedly, and in many cases it has run up as high as 12 per cent. What does this mean? Does it mean that it would pay to have a man at each boiler, and simply attend to it alone? No. It does not: for the simple reason that the less a man has to do the less he is inclined to do, and this applies more to firemen than to any one else. I might state that when we were testing the Jones Stoker we had long periods where we had competitive tests, and others again when we run as in ordinary practice: that is to say, the firemen doing just precisely as he would do if no test was being made. The coal and water, however, were measured in each case. The results were simply astonishing. In the ordinary running test the Jones Stoker would do about 50 per cent. more work and nearly 25 per cent. better economy, whereas with the competitive test the work done on the stoker was about 25 per cent. more, and 15 per cent. increased economy, which bears out the statement that between competitive and ordinary running we have a difference of 10 per cent. Now which is the correct way to look at this matter? Can we obtain

*A paper read before the Canadian Association of Stationary Engineers.

results right along with hand firing equivalent to those obtained during a competitive test? I do not think so, because firemen, as a rule, do not like to be beaten, and will do their very best during a competitive test to do up the other fellow; but at the same time he is wishing inwardly that the test was over so as to get back the old "style" again.

There are many plants in Canada where very good results are obtained if we take the results as made by the engineers into consideration, several of them showing a usual 14 lbs. evaporation per lb. of coal. This you will readily understand is out of the question. There are also a large number where very poor results are obtained, and these poor results are due to several causes, namely: Boilers in very bad order, dirty tubes, poor setting, poor boilers, poor firemen, etc. The man who sells boiler compounds will in all probability say that you do not use enough of his compound; your answer to that is, of course, that there are compounds on the market that are absolutely of no use whatever, and it is simply throwing money away to buy it. I myself believe in a good compound, but will admit that it is difficult to get it. You may get one barrel (the first from a new maker), fairly good, the second of no use whatever, and so on it goes. A good compound is required, and to my mind to-day we have not such a thing. All compound makers state in their advertisements to send on a sample of your water, and they will give you the very compound you require after analysis. You, of course, know what this means—that if one brand does not work they will send another brand of practically the same stuff with another name and try it. Poor boiler and poor setting; this is attributed to trying to keep down the first cost. Pay a good figure for a good boiler and have it set by competent men. Poor fireman; this is in my humble judgment the most important item, and one that should receive much consideration. The fireman may not be poor, but the work that he has to attend to, namely, firing too many boilers, makes him feel that he is neither more or less than a laborer, and as long as he keeps the steam pressure up, no matter how much coal he burns, or how he does it, there appears to be little or no attention paid to him. There are many places where the fireman is never thought of except when the steam pressure goes down, and when such is the case the usual deputation calls upon him to ascertain if he is asleep or not. A good fireman is really a skilled workman, and should be treated as such. He should receive a fair salary, and his employer should bear in mind that any reduction in his pay is far from being a saving. If he is cut down $2 per week you will in all probability find your coal bill increased about $8, and there is not much economy there. How are we to obtain better results in our boiler rooms? I think by putting in machines to do the work, and having men simply to look after them.

EVAPORATION AND THE RAISING OF STEAM IN BOILERS.*

BY P. MACNAUGHTON, MONTREAL.

From the title of this paper you will notice that it is to deal with two things. First, evaporation, and second, the making of steam in boilers. These two actions are often considered as if they were distinctly different, but, I think, it can be shown that the actions are the same in the end, and that they differ only in the way in which the end is reached. In the following remarks it will be noticed that I have tried to show how the natural action of evaporation resembles the action of making steam for power, because it is always instructive to think out how the processes which we make use of every day, compare with corresponding ones in nature. Some have said that it is wasting time thinking of things in this way; if they really think so it would be wasted time, but to others it would be very instructive and pleasurable. I might say that such thoughts would be to them as salt, which though of little use in itself as a food, still makes our food more palatable. Strictly speaking the term evaporation is used to denote nature's method of changing water into vapor, and making steam in boilers is part of man's method of changing water into vapor through an intermediate state familiar to all of us called steam.

The principal actions in nature in which evaporation plays a part, have been noticed by all of us. They are the disappearing of the dew from the grass on a summer morning, and the frost later in the season; the disappearing of water when left standing in open vessels, and on a much larger scale the raising of water from our rivers, lakes and surrounding ocean. Now it is usually admitted that for every action there is a cause, and the cause of evaporation in nature is the heat of the sun. It will make our problem much simpler if we consider, for instance, a bucket of water as made up of a great number of particles of water. That this is the real state of water will be seen at once if we remember that when heat is applied to water it forms steam, which is particles of water visible to the eye, and if heat be applied to steam the particles of steam are divided into smaller particles called vapor, which is invisible.

Atmospheric air, among other things, contains a certain amount of water vapor, and this water vapor as long as the sun is shining is kept suspended uniformly through the atmosphere by the sun's heat. When the sun has set and its heat no longer acts on the atmosphere this water vapor tends to condense to a slight extent and with this condensation it becomes slightly heavier than the other components of the air, and so tends to sink towards the earth, so that in a calm, clear night in summer that part of the atmosphere lying next to the earth contains more moisture than that which is higher up.

That the above statement points out the true state of the atmosphere at night is proven by noticing the land fogs. If we go up a mountain at the first of daylight on a calm, foggy morning we will notice that as we ascend the fog becomes less dense until when we have gone up about four hundred or six hundred feet we will be out of the fog altogether.

This layer of moist air coming in contact with the cool leaves of trees, plants and other vegetation, the water vapor which it contains is further condensed, thus forming dew. I wish it to be clearly understood at this point that the collecting of dew on the leaves of plants is owing to condensation and not to a falling of water as rain. The fact that dew only gathers on the top side of the leaf, and does not collect in our houses even if all the doors and windows are open, is owing to another action which has no bearing on the subject in hand.

Now we come to evaporation or the disappearing of the dew. We have the air in two layers, the moist one lying nearer the earth and the dry one higher up. The sun rising in the sky begins to send his rays of heat earthward, the layer of air lying next the earth becomes warmed first, and owing to the principle that warm air rises, it rises, and the cooler air comes down to take its place next the earth. The air which is now next the earth is dry or lacking in water vapor, so the lack is made up by absorbing a certain amount of water in a state of vapor from the dew on the plants. This circulation has not continued long before all the dew is evaporated. This process of evaporation in nature does not cease when the dew has disappeared, but goes on continually, because there is always a demand for more water-vapor in the air on account of it being partially condensed in the upper regions of air, thus forming first, clouds, and if condensed further the clouds form rain or snow.

We will now proceed to discuss the making of steam in boilers, and then its change from steam to water-vapor, after which we will compare it with the process described above. For purposes of comparison we will turn water into steam in a boiler open to the atmosphere, that is to say, we will raise steam under a pressure of 14.7 lbs. per square inch. In this we are under the same condition as the dew which was turned into vapor under atmospheric pressure also. We will suppose that the boiler which we are going to use is a small circular vessel, say 6 inches in diameter and 12 inches deep, which may be set over a stove hole, and supplied with a steam tight cover somewhat like a piston, by using which we may vary the pressure. We will now put some water in the boiler and place it over the fire, the cover being left off. Now, remembering that water is made up of particles held together by a force (in this case 14.7 lbs. per square inch, or whatever the barometer may read), which must be overcome before we can have steam, we are called upon to exert a force in opposition to the force holding the particles together. We do this by lighting a fire under the boiler. As the fire burns a certain amount of the energy of the coal is transferred to the water, causing the temperature to rise until, when it has reached about 212° F., the coal has transferred enough of its energy to the water to enable it to overcome the atmospheric pressure and water pressure, and

*A paper read before the Canadian Association of Stationary Engineers.

steam is given off. Now, we have water in a state of steam, which is visible to the eye. If we watch the cloud of steam as it rises upward, it will be noticed that it gradually gets thinner and thinner, until at last it disappears from view. What has become of it? We have produced the invisible water-vapor, and it has been absorbed by the air.

The change from steam to vapor took place like this. In a boiler it is the water which lies next the surface exposed to the fire that is first turned into steam. In order to do this the coal must transfer energy to the water to raise not only the atmospheric pressure, but also the pressure due to the depth of water in the boiler. Now when the particles of steam emerge from the surface of the water they are under a less pressure than when at bottom of the boiler, and so contain more heat than is necessary to keep them as steam. This surplus heat or energy causes an expansion or bursting of steam into the smaller particles, which constitutes water-vapor, which is absorbed by the atmosphere.

This last expansion is on the same principle as when we open a try cock below the water line on a working boiler, it is not water which blows out but steam or vapor. We will now sum up these two operations. In the first the heat or energy of the sun does work on the atmosphere, thus setting the air in circulation, and as a result of the air circulating water is absorbed. In the second the heat or energy of the coal does work on the atmosphere, setting free the steam, and at the same time storing in the particles steam and energy, which turns the steam into vapor when it rises into the air. From the above conclusions we see that evaporation, or nature's method of making water-vapor, and the making of steam at atmospheric pressure and its change into vapor, differ only in the two forces that produce them.

In reference to making steam in boilers there are two interesting cases besides the one which we have just discussed, namely, making steam under a pressure greater than the atmospheric pressure, and under a pressure less than the atmospheric pressure. Dealing with the first mentioned case, that is, where the pressure is greater than the atmospheric pressure; this condition can be brought about by fitting the steam-tight cover on the boiler mentioned in the first case and putting some weights on it to the amount of 5 lbs. per square inch. Now, instead of steam being given off when the water is at about 212° F., it will not be given off before the temperature is 226° F. This increase in temperature is due to the fact that before steam can form in this case the coal must transmit to the water enough of its energy to raise 19.7 lbs. per square inch instead of 14.7 as before. This condition of things comes about naturally when boiling water in mines, for as we descend into the earth the atmospheric pressure increases, which corresponds to the added weight.

Lastly and briefly we will consider the making of steam under a pressure less than the atmosphere at sea level. For this we would have to exhaust the air from our boiler by an air pump or other means. Then we would find that steam would be given off when the water is at a temperature less than 212° F., according to the amount by which the pressure in the boiler is less than atmospheric pressure. This shows that as there is less pressure keeping the parts together in this case than in the other two it therefore requires less energy to set the steam free. As an example of this in nature it has been noticed by travelers going up mountains that when they got high up it takes a much longer time to boil eggs than on the plain below, although the water in giving off steam went through the same action in both places. This was due to the fact that at the top of the mountain the pressure of the atmosphere was less than at the bottom, and the water though giving off steam did not contain the heat necessary to boil the eggs. I think if these travelers had been engineers they would have piled some stones on the lid of their kettle in order to save time.

In this case it is interesting to notice that although it requires less heat to raise steam at a high elevation than at the ordinary atmospheric pressure at the sea level we do not gain anything by reducing the pressure, because when we sum up the heat required to raise the steam, and the force required to reduce the pressure below the atmosphere, we will find that it will amount to the same thing as if we were making steam at atmospheric pressure.

OILS FOR THE ENGINE ROOM.*

BY JULIUS M. WILLIAMS, CHEMIST, HAMILTON.

This subject is considered as being important enough to justify considerable attention from engineers, and this paper being much appreciated by the local association, it is by their request read before the convention, and it being considered inconvenient to repeat the full text, it is condensed, and samples of oils and the products of their decomposition are for the same reason not shown. The matter is treated in the following divisions:

1. Relation to the machine, the prime object of oil is to reduce friction, consequent to the effort of the motive force to overcome the resistance of the weight, that is the work of the machine.

2. Nature of the material, fluid, capable of passing between tight fitting surfaces either voluntarily or by mechanical means, non-resisting, especially free from abrading particles, and from corrosive qualities.

3. Possessing sufficient viscosity and specific gravity to be of service; absence of viscosity and low specific gravity being in inverse relation to the strain or weight on the bearings.

4. Nature of the machine and its special conditions.—The points of friction usually called bearings, consisting of two close fitting surfaces, one or both moving, either rapidly or slowly.

The conditions being mainly that of temperature, this suggests the division of bearings into two kinds, hot and cold: cold bearings being considered first as being the earliest in use and embracing the largest number, these are exposed to a range of temperature extending from the average of 100° F. at the top of a room to that of winter weather outside; mechanical contrivances dispose of many of the difficulties met with on account of variations due to temperature.

Hot bearings are few and include cylinders, pistons and cut-offs.

5. The requirements or qualities of the oils to meet these conditions:—

They should be clean, free from abrading substances.

Non-resistant, free from resinous constituents.

Non-volatile, permanent, so that bearings will not "go dry."

Non-drying, free from "gumming" propensities.

Neutral, free from organic or mineral acids, the first due to rancidity, the second to the refining processes.

6. Hot bearings.—To meet the conditions of the very high temperatures of the principal hot bearing, the cylinder oils require to be of high stability and especially free from the substances before mentioned, that is, volatile, resinous, and decomposable ones, owing to the fact that fixed oils decompose at 600° F.; in the presence of steam with the production of fatty acids and glycerine it is evident that oils partly decomposed, rancid, are not desirable in a cylinder.

7. The constitutional nature of oils.—They are supplied by the three kingdoms, animal, vegetable and mineral.

The animal oils are of great variety and from many sources, the principal ones being the meat and fish trades; these include the various refuse handling sections of those trades, whence are supplied vast quantities of oil.

There may be enumerated here in the order in which they predominate the animals whose oils we use in this country: The hog, horse and cattle; of the fish, cod, whale, sperm whale, etc.

The vegetable oils will be familiar as olive, castor, cotton-seed, earthnut (peanut), and are variously the product of seeds, nuts, fruit.

The mineral oils constitute by far the greatest part of the oils in use as lubricants, and are used alone or in combination with oils from the other two sources. Mineral oils possess in their wide range of varieties all the requisite qualities of good lubricants.

*A paper read before the C.A.S.E.

FOR THE FIRST PLACE IN AMERICA.

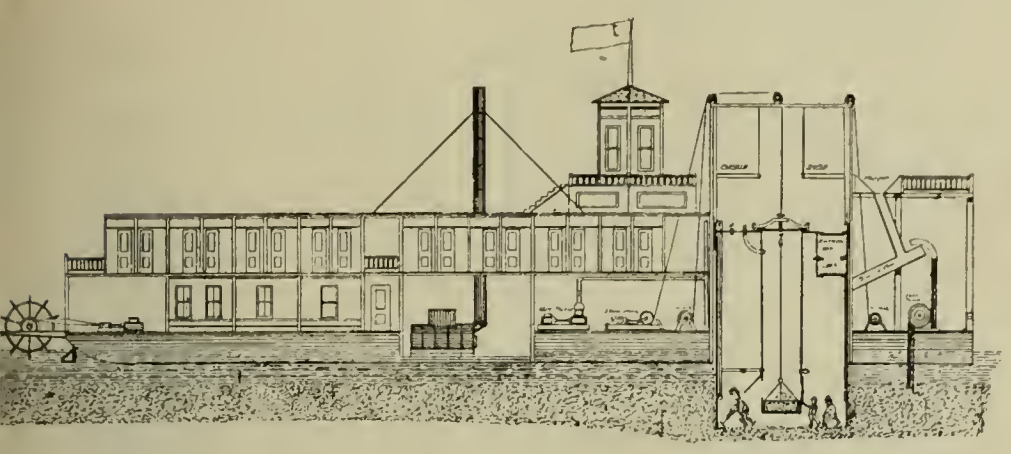
I enclose herewith $1, my subscription for this year, and I am glad to notice the almost monthly improvement in the paper, and congratulate you heartily on the success of your venture. I would like to see The Canadian Engineer competing with The Scientific American for the first place in America.

Yours sincerely, E. ROCHESTER.

54 Rochester street, Ottawa, Aug. 16, 1898.

A NEW GOLD DREDGE.

A number of tests have been made at Vancouver, B. C., recently, of the model of the pneumatic caisson and air lock elevator, invented by Garrison & Wood, and which has been built by them for test purposes there. In every case the tests have proved the invention to be most valuable for the recovering of gold from the bars and beds of rivers and creeks. The model of the caisson and elevator are built into a scow for temporary purposes, but the permanent machine is to be placed



THE CAISSON ELEVATOR IN OPERATION, SHOWING MEN AT WORK IN BED OF RIVER.

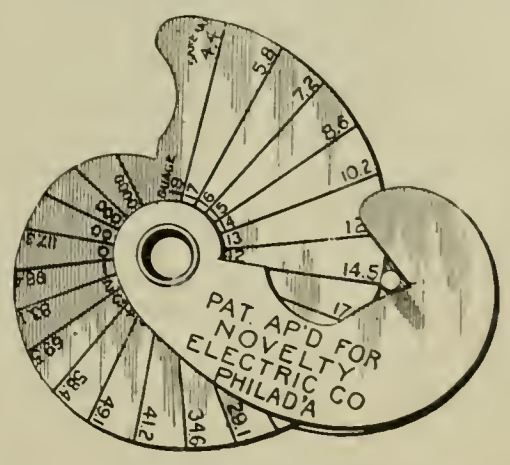
on a sternwheel steamer. The model itself has a caisson 5 feet by 8 feet, but the complete machine will be built of steel, and the caisson will be 10 feet by 20 feet, so as to allow six men to be at work at one time. Entrance to the upper air-closed chamber is obtained through an opening in the top, and when the workmen are all in, the opening is sealed up and the clamps over the opening to the lower chamber are removed, and the bed of the river is reached by means of a ladder. Before the workman goes on board, however, all the water will be removed from all the chambers by air pressure, which will vary from 2½ lbs. to 15 lbs. per square inch according to the depth to be reached. On reaching the river bed, clamps are removed from the elevator shaft and the workmen begin excavating, and shovel the dirt into a bucket in the elevator. When the bucket is full the elevator shaft is closed tight, a signal is given, and the shaft is opened at the top, the bucket is hauled up and its contents emptied on to the dump. It is then lowered into the shaft, which is again hermetically closed at the top, a signal is given and the fastenings below are removed, so that the whole process can commence again. C. C. Bennett, of F. C. Innes Co.'y, Ltd., Vancouver, B. C., is the agent of the invention for Canada.

REFRIGERATING MACHINES.

A correspondent of Fairplay, London, writes: As a result of the recent extensive additions J. & E. Hall, Limited, have made to their works at Dartford, Kent, which, by the way, is the third time this has been necessary during the past few years, I hear that they have been turning out refrigerator machines on their patent carbonic anhydride system for the last four months at the rate of fifteen per month, that is to say, a total of sixty machines in four months. This is a result that they may well be proud of, as many of the machines were of large size, such as those for Houlder Bros. & Co.'s two latest ships, which have a capacity for over 2,000 and 3,000 tons weight of meat respectively; also those for the White Star Line for their S.S. Nomadic and Tauric for the carriage of chilled beef; machines for the United Steamship Company of Copenhagen for the carriage of about 900 tons of butter and bacon in each ship; and for Thos. Wilson, Sons & Co., in the same trade. The British Admiralty have had several more machines from Messrs. Hall, and the new Japanese battle ships have been fitted by them. For the carriage of fruit and preserving provisions, etc., Messrs. Hall have executed further orders for the Union Steamship Company and Donald Currie & Co. Other machines have been supplied to the Oriental Steamship Company of Japan, the Nippon Yusen Kaisha, Baron Rothschild's new twin-screw yacht, the Atmah, the Russian Volunteer Fleet, and many other vessels. They still have in hand orders for no less than 75 machines, either fitting or to be fitted on board ship, besides a large number of machines for land purposes, which comprise almost every trade for which refrigeration is required. It is interesting to note that J. and E. Hall have fitted and have on order for the largest steamship companies no less than nine installations each for two of those companies, also orders from seven other companies that run into from four to six installations apiece, and orders for ten, seventeen, eighteen, twenty-three, twenty-eight and thirty installations respectively, for other companies. A description of some of these machines will appear in another issue of The Canadian Engineer. The London office of the company is at 23 St. Swithin's Lane.

HOW TO USE THE ELECTRIC WIRE GAUGE.

Place the wire in the V-shaped opening between the movable arm and the edge of the gauge. Move the arm around until the wire is tightly bound against the edge. On the front of the gauge the figures above the short, square shoulder, near the centre, show the American (B. & S.) gauge of the wire. The figures on the outer edge of the gauge on small line, show the amperes the wire will safely carry before heating to 30 degrees above the temperature of surrounding air. On the back of gauge the ohms resistance is given of a foot of copper wire, of any size, as shown by the gauge. To find the resistance of a foot of iron wire, multiply the resistance of a foot of copper wire by seven (7). To find the resistance of a foot of German silver wire, multiply the resistance of a foot of copper wire by thirteen (13). To find the number of lamps a wire will carry: Bear in mind that a 50-volt lamp takes 1 ampere, a 75-volt lamp ¾ of an ampere, and a 110-volt lamp ½ an ampere of current. From the gauge, get the size of wire and its safe carrying capacity in amperes. The wire will carry as many lamps as the current of one lamp of a given voltage is contained in the ampere capacity of wire, as shown by gauge. Example.—The safe ampere capacity of No. 12 copper wire B. & S. Gauge is 14½ amperes, and one 110-volt lamp requires ½ ampere of current; therefore, $\frac{14\frac{1}{2}}{\frac{1}{2}} = 29$, the number of lamps a No. 12 B. & S. gauge, copper wire, will carry. To find the size of wire required to carry a given number of lamps, at a given distance, at a given loss.—Taking the formula as stamped



on arm gauge: Let V represent the volts loss, C represent the total amperes and D represent the distance in feet (both ways). Example.—Desiring the size of a feeder wire that will carry 20 amperes at a loss of 10 volts, 400 feet (800 feet both ways). V = loss in volts, which, in this case, is 10; C = total amperes, which, in this case, is 20; D = total distance in feet, both ways, which, in this case, is 800. Therefore, $\frac{10}{20 \times 800} = \frac{10}{16{,}000}$ .000625, the resistance of one foot of copper wire. Having this result, place the square shoulder of the gauge-arm on line with the nearest resistance to said result that is found on the gauge, and the square shoulder on the reverse side will indicate the B. & S. copper wire gauge desired; in this sample case, it will be found to be No. 8 wire. For sale by Aikenhead Hardware Co., 6 Adelaide street East, Toronto.

James Stewart & Co. are at work on the foundations of the new bridge to be constructed across the Niagara River at Lewiston.

The St. John, N. B., Globe says: The building of the Cushing Sulphite Pulp Company's mill is now an assured thing, for one English paper maker has taken three-quarters of the stock and more than one-half the remainder has already been subscribed by local capitalists.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during July and the seven months ending July, 1897, 1898 :—

	Month of July.		Seven months ending July.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£5,825	£2,372	£37,755	£14,290
Pig iron	942	928	3,807	7,105
Bar, etc.	786	502	5,799	7,239
Railroad	17,368	8,190	37,654	23,007
Hoops, sheets, etc.	8,313	7,843	31,003	24,466
Galvanized sheets	6,083	8,294	25,458	32,461
Tin plates	5 989	12,123	94 942	85,598
Cast, wrought, etc., iron	1,943	2,295	19,277	18,637
Old (for re-manufacture)	1,080	499	2,577	3,574
Steel	6,099	5,040	29,537	32,897
Lead	3,699	4,170	10,959	16,460
Tin, unwrought	345	1,638	10,179	12,423
Alkali	2,289	3,587	17,649	24,597
Cement	1,934	2,270	8,489	12,222

THE USE OF IMPROVED METERS IN ELECTRIC LIGHTING.

It has been found by experience, it is stated, that a central lighting station can supply 30 per cent. more customers on the meter than on the flat rate. This 30 per cent. really represents wastefulness, which is inherent in the nature of the average customer, and the flat rate. The investment in meters, and their proper care, makes the plant equivalent to one 30 per cent. larger. A central station which is in the electric lighting business for the profits on its investment can easily realize the great advantage in the use of meters. That many small villages and cities make but a small profit, or the income only sufficient to pay actual running expenses, is not surprising, in view of the waste and extravagance of the flat rate. These same stations may, by proper and economical use of meters, be made profitable. It is not necessary to point out the evils of the flat rate; but it is self-evident that many customers never take the trouble to turn out all or part of their lamps, and in places where the plant gives all-night service the lamps are left burning all night. A fallacy in flat rates is the basing of charges on 50-watt lamps. A 50-watt 16-c.p. lamp is somewhat of a rarity in the market, 60 watt being about an average, and many lamps are used taking more even—70 or 80-watts. In most small stations the voltage is kept above what the lamps were made for; even in the case of a 50-watt lamp the consumption will be higher. It has been found that most small stations, if they use 50 volts, keep the voltage at 55 or 60. These wastes are impossible to avoid in the flat rate. A meter measures the actual consumption of current. The central station gets paid for actual service given the customer, and it behooves the consumer to use his lights in the best and most economical way.

New Scheefer watt-meter for alternating current has been devised to correct various faults which were in the Scheefer meter, which has given such good results, states the Packard Electric Company in a recent circular. As will be noticed, the meter is round and has a rubber band placed around the circumference, over which is placed the other case. This rubber band should always be used, as it makes the meter perfectly dust and bug proof. It has been found that meters with cases of ordinary fitting are hampered with dust and dirt; and with such cases it is impossible to keep meters correct, necessitating frequent overhauling and cleaning. The Packard Company's new meter, if the case is properly put on with the rubber band, is perfectly air tight, and gives an assurance of its permanency. The binding posts will be seen to be insulated in a thorough manner, ordinary holes not being depended upon. The holes in the binding part are closed on end and insulated by hard rubber, making it impossible that anything can get through the post; and also making it unnecessary to tape or plug any holes. The moving parts are extremely light—at the same time not too delicate. The iron circuit in the magnetic system is practically a closed one, preventing stray lines of force from acting on other parts of the meter, and is therefore unaffected by outside influences. This closed circuit gives the maximum effect with the minimum energy possible in construction, the shunt winding taking about 1-3 to 1-2-watt on 15,000 alternations, and not exceeding ½ to ¾-watt on 7,200 alternations. This meter is also said to be correct on inductive loads, and therefore can be used on fan motors or induction motors, arc lamps, etc.

Industrial Notes.

Joseph Carrington is building a large addition to his tannery at Kingston, Ont.

Mayor Roy, of Levis, is negotiating with Montreal capitalists for funds for an aqueduct for that town.

Dr. Bryce of the Ontario Board of Health has reported that additional sewers are needed at Kincardine, Ont.

The Ontario Silver Co., Humberstone, Ont., has installed a second gas engine recently; the new one being 40 h.p. capacity.

H. Mooers & Co., of Kingston Ont., are about to build a new flour mill, which will be run in connection with their elevator.

Lancaster, Ont., village corporation is looking for some industry or industries to locate in the town. Good inducements are offered.

It is said that a shoe factory is soon to be established at Fredericton, N. B.; $20,000 of the required capital has already been subscribed.

McDonald & Allen, manufacturers of door knobs, Kingston, Ont., have closed out. The plant has been bought up by Mr. Spencer, who will reorganize the business.

M. Fauteux has the contract of building the new hospital at Sault Ste. Marie. The work is estimated to cost $20,000. and is to be completed by the 10th of January, 1899.

Engineer C. H. Mitchell, Niagara Falls, Ont., writes that the town is about to construct 8,700 lineal feet of 6, 8 and 10 foot concrete and brick walks, together with stone curbing and crossings.

The Peterboro, Ont., Light & Power Co., is about to commence the erection of a large water power station. The new station will cost between $30,000 and $40,000, and the company expects to develop about 2,000 h. p.

The contracts for the new iron bridge over the River Raisin at Lancaster were let, and Williams & Fallon, of Cornwall, Ont., have commenced work on the abutments. The Dominion Bridge Co. will supply the structural work.

The Ontario Board of Health has given Fort William, Ont., permission to take the supply of water from the Kaministiquia River three miles above the town, provided that the sewer outfall should be a quarter of a mile from the mouth of the river, emptying into the bay.

It has come to our knowledge that certain bogus or fraudulent firms in Holland are entrapping Canadian manufacturers in the iron trades, and we would sound a note of warning that no goods be shipped without security in some form. Could not our boards of trade look into the matter ?

The demand for Clappison's magnesia sectional covering has been so great that it has become necessary to greatly enlarge the factory at Hamilton, Ont. Another story and a new engine room—an entirely new front—new machinery, etc., having been added. This goes to prove that a really good article, once used, is sure to be appreciated.

The hydraulic jacks recently shipped to the Intercolonial Railway Co. by the Lancaster Machine Works, are reported to be first-class articles giving great satisfaction. These jacks, although retaining the main original features of the Tangy jacks, have several improvements that place them ahead of all other makes. They are made in all sizes by the Lancaster Machine Works, Lancaster, Ont.

In the paragraph last month referring to the transfer of certain oil properties to the Bushnell Co., Ltd., of Sarnia, omission was made of the transfer of the National Oil Co., of Petrolia (owned by John Macdonald), at $65,000. The price at which the Empire Oil Co., of London (owned by J. R. Minhinnick), was transferred was stated to be $4,000 instead of $28,000.

The Athens, Ont., Methodist congregation will build a new $10,000 church.

Newmarket, Ont., has carried a by-law to give $5,000 to the Office Specialty Manufacturing Co. to extend its buildings.

The contract for the Ashburnham waterworks system has been awarded to McQuillan & Co., of Toronto, at $6,295.

The new ranges of the Dominion Rifle association at Rockcliffe, Ottawa, are provided with acetylene gas lights instead of electric lights.

J. E. Webb, who was contractor for the masonry on the Union station, Toronto, is building a large generator house for the Consumers' Gas Co., Toronto.

Jno. Galt, C. E., Toronto, has made preliminary surveys and examinations at Stayner and Bolton, Ont., for the proposed installation of waterworks in those towns.

The matter of the contemplated bonus to the proposed rolling mills in Belleville, Ont., will not come before the ratepayers for some time, as a great deal of opposition has recently developed itself locally.

Dr. P. H. Bryce, secretary of the Ontario Board of Health, reports that the residents of Niagara-on-the-Lake are taking the sewerage question into serious consideration, and hope in a short time to have a modern system in operation.

Alex. P. McKee, proprietor of a glass factory in Anderson, Ind., was recently in Hamilton, Ont., with a view to establishing a factory there. The report that the Diamond Glass Company proposed to move to Toronto was the cause.

In St. John, N. B., the city engineer is carrying on the annual clearing of the city water mains. In the leading Ontario cities when the water mains become choked up with sediment they lay new and larger ones.

The waterworks just completed in Mount Forest, Ont., were tested August 30th, and found entirely satisfactory. The work was carried out at a cost of about $30,000 by Clark & Connelly, contractors, Toronto, upon plans prepared by Jno. Galt, C. E., Toronto.

D. S. Collins, manager of the Fossil Flour Company's mills at Bass River Lake, Castlereagh, Londonderry, N. S., is pushing the works, and the product that is now coming from the mill is said to be most satisfactory. The mill is turning out from 10 to 13 tons of refined silica every day. It is brought over the Pole Railway to the wharf at Bass River for shipment.

The Brockville Pork Packing Company has been organized with W. H. Comstock as president; Mr. Packingham, treasurer; Mr. McLennan, secretary, and E. C. Manning, formerly of Dublin, Ireland, as manager. The buildings for the new company are being got into shape, and the factory will soon be running.

Last month an article appeared in the columns of The Canadian Engineer describing the Sterling Hack Saws, which are a great labor-saving device; the makers' name and that of the parties selling same in Toronto were omitted. The Diamond Saw & Stamping Co., of Buffalo, manufacture these goods, and samples will be sent free and prices quoted on same by Aikenhead Hardware Co., 6 Adelaide street east, Toronto.

The Britannia Co., of Colchester, Eng., have sent us a neat souvenir in the form of a nine inch rule with one edge beveled to form a letter opener. This company manufactures various specialties in tools, and has just issued leaflets descriptive of their lathes with turret rests and capstan rests, for milling machines, and headstocks for the same, dividing appliances, engineers' vices, turret screw cutting lathes, boring machines, shapers, etc.

The General Engineering Co., of Toronto, Ltd., are prosecuting an action, taken out last July, against the Dominion Cotton Mills Co., of Montreal, and the American Stoker Co., for infringement of patents. The statement of claim sets forth that the plaintiffs are owners of patents granted in 1892 and subsequent years for improvements in boilers and furnaces and for mechanical stokers, known as the Jones Underfeed Mechanical Stoker, which patents the defendants have infringed. Damages are sought for these infringements, and an injunction is asked for restraining the defendants from using such mechanical stokers, etc. The action is taken in the Exchequer Court.

A bonus of $2,500 is offered for the erection of a 50-barrel flour mill at Carnduff, Assa.

D. W. Karn & Co., Woodstock, are erecting a $3,000 addition to their organ factory.

Charters Smith, Durham, Ont., has his foundry, which was burned down some time ago, in operation again.

Geo. H. Hees & Co., Toronto, window shade manufacturers, have taken out a building permit for a three-story brick factory to cost $9,000, and a three-story brick warehouse, beside the factory, to cost $7,000.

Oshawa, Ont., has instructed Jno. Galt, C. E., to make preliminary surveys and estimates for a system of water supply and sewage disposal for the town, to cost about $100,000. The water supply is to be by gravity from springs in the Oak Ridges.

The difficult work of taking down the old Victoria bridge, Montreal, is being made somewhat easier by the use of pneumatic machines to cut the old rivets. The Ontario Rolling Mills Co., Hamilton, Ont., has bought the material of the former structure.

A great many elevators are being built in the Northwest this season. The Northern Elevator Co. has ten elevators under construction at the following points: Oak River, Varcoe, Pettypiece, Cypress River, La Salle, Starbuck, Elm Creek, Somerset, Swan Lake and Union Point, Man. Each of these will have a capacity of 30,000 bushels, and a few others will be erected later on in the season. When those mentioned are completed the Northern Elevator Co. will have 102 elevators in the province and Territories. Besides the five to be built for the Lake of the Woods Co., E. J. O'Reilly has about completed an elevator for the Richardson Grain Co., of Kingston, at Sydney, to replace the one destroyed last winter. The Manitoba Grain Co. will also erect a number, and it is understood the Dominion Elevator Co. will add to their storage capacity. Bready, Love & Tyron will spend about $50,000 in erecting elevators at thirteen or fourteen provincial and Territorial points.

The Dodge Manufacturing Co., Toronto, Ltd., has been incorporated and will carry on the business hitherto conducted by the Dodge Wood Split Pulley Co., with works at Toronto Junction, and warerooms and city offices at 74 York street. The Dodge Manufacturing Co. will continue to manufacture the Dodge Wood Split Pulley. It will also do a general foundry, engineering and machine shop business, making a specialty of power transmission machinery, such as shafting and pulley equipment, jack shafts, floor stands and friction clutch pulleys. The firm will also make a speciaity of grain elevator machinery and rope driving. The Dodge Co. has every facility for turning out high class work quickly, and are prepared to make plans and submit estimates and give information on all kinds of special machinery. The company issues a 270 page catalogue which will be mailed free on application.

Freeman C. Coffin, engineer to the city council of Carlottetown, P. E. I., prepared the plans adopted by the Sewer and Water Commissioners for a complete sewage system for the city. The system decided upon is the common separate water carriage system with intermittent discharge into the sea by means of a reservoir, cast iron pipe and the channel of the Hillsborough. There will be a pumping station at a low point both on the east and west sides of the central high gravity area, which location of pumps will altogether obviate the use of siphons and at the same time carry away the sewerage from the lowest levels to the eastern and western portions of the city. From each of the pumping stations already mentioned, and the tank connected therewith, the sewerage will be pumped through a cast iron pipe to an elevation of about 20 feet on the high gravity area, where it will enter an earthenware pipe of a large size to enable it to flow freely with the other sewerage passing at the same level into the outlet reservoir. It is proposed to erect an outlet reservoir at or near the head of Pownal wharf, 40 feet by 90 feet inside measurement. This reservoir will be covered with an arch roof of concrete, to effectually guard against the escape of any foul odors. From this reservoir, running between Pownal and Connolly's wharves, there will be a 20 inch cast iron outlet pipe of the approximate length of 700 feet, or until it reaches well out into the channel of the Hillsborough.

Parry Sound, Ont., has ordered a rock crusher.

The village of Gatineau Point, Que., has voted to establish water-works.

The contract for the new breakwater to be constructed at Goderich, Ont., has been awarded to Sneeth & McGillicuddy.

J. A. Savoie, box manufacturer, Brompton, Que., will move his factory to Sherbrooke, where he will employ about fifty men.

J. E. Wilson, St. John, N.B., has received from the C.P.R. the contract to furnish 3,000 steel buckets for the new elevator conveyors.

Mayor Andrews, of Winnipeg, has gone to England to float a bond issue to provide for the construction of a city water-works system.

It is proposed to erect the new dynamite works of the Ottawa Dynamite Company on a site between the Ottawa river and the Richmond road.

The Waterloo township, Waterloo County, Ont., by-law to raise $9,000 for the purpose of replacing the bridges swept away, was carried last month.

A by-law to provide $40,000 for waterworks purposes, repealing the by-law for $35,000 already voted, was defeated in Fort William last month.

Voting on a by-law for the establishment of a waterworks system, took place at Prescott, Ont., Aug. 18th, and it was carried by a majority of 124.

Berlin, Ont., has an old hand fire engine that has a history. It was purchased on December 19th, 1857, from George Penny, of Montreal, for £219 9s. 11d.

The contract for the building to be erected on the site of the old City Hall, Quebec, has been awarded to Joseph Gosselin, of St. Joseph de Levis, at $75,000.

A bylaw to raise the sum of $30,000 for the purpose of erecting new municipal buildings, in place of those burned last November, was carried at Stratford recently.

Wm. Thompson, expert of the Caledonia Iron Works, reports that he is making rapid progress with the installation of the waterworks plant at Rat Portage, Ont.

A Dominion charter is asked for a company to build a general traffic bridge over the Ottawa from a point in Ottawa city, between Bank and Kent streets, to the city of Hull, Que.

Recent fires in Montreal have caused an agitation for fire tugs, which are necessary to the protection of a harbor, and are in use in all the chief harbors of the United States.

An elevator is being erected at the linseed oil works, Winnipeg, and considerable new machinery has been installed in the works, increasing the capacity and efficiency of the industry.

The acetylene gas plant installed this summer in the Algonquin hotel, Stanley Island, Ont., by the Hamilton Acetylene Gas Machine Co., is giving complete satisfaction. There are 150 lights.

Dickson Bros., iron founders and machinists, Campbellford, Ont., have been awarded the contract for the steel bridge across Crow River, eight miles north of Campbellford, for $1,900.

The People's Light & Power Co., Halifax, N. S., has added to its plant by purchasing through the Halifax office of the James Cooper Mfg. Co., another 50-h. p. Lidgerwood hoisting engine.

The contract for the re-building of the portion of St. Bernard's Convent, Antigonish, N.S., destroyed by the recent fire, has been awarded to Angus McDonald & Son, Truro, N. S. Their tender was $11,342.

The W. C. Edwards Co., Ottawa, is erecting a retort for the manufacture of calcium carbide gas from sawdust and limestone. A description of the process will appear in an early number of the CANADIAN ENGINEER.

The Reids of Montreal have laid before the Newfoundland Government their plans for the erection of a pulp mill at Grand Lake. It is to be a company with a capital of $2,000,000, which has already been subscribed. The mill is to have the capacity of 162 tons of dry pulp per day, and for this purpose will use 450 cords of spruce daily.

The assets of the Cascapedia Pulp & Lumber Co. were sold at auction recently. R. H. McLelland, of St. John, N.B., bought the saw mills and machinery for $15,000, and the Salmon River timber limits for $2,900.

An order has been placed with the James Cooper Mfg. Co., Ltd., Montreal, by the Canadian Construction Co., Farrans Point, Ont., for two of the Lidgerwood type double cylinder double drum hoisting engines, complete with boilers.

Architects are asked to compete for plans for a Presbyterian church, Windsor, N. S., seating capacity 500 or thereabouts, and of schoolroom 250, of wood, to cost not more than $12,000 fully finished, including lighting and heating; if of stone, to cost not more than $16,000, finished, lighted and heated.

The Nova Scotia Glass Co., South Trenton, N. S., has sold its works and plant to the Diamond Glass Co. The works have been closed since 1892.

Later reports show that the damage to the works of the Jenckes Machine Co., at Sherbrooke, Que., by fire on the night of the 13th of August, was very much exaggerated. The fire was confined to the machine shop building, and the other departments, foundry, boiler shops, etc., were in operation as usual on the following Monday. A few days later a portion of the machine shop was started up, and the whole was in running order in a very short time. The patterns, drawings and office records were preserved practically intact, and all orders for work are being accepted as usual. The principal item requiring replacement is the roof of the machine shop; this, however, is well under way. The whole of the work is being pushed with much energy, and the numerous orders in hand will suffer comparatively slight delay.

The International Correspondence Schools, of Scranton, Pa., have decided to place representatives in the Canadian field, and will in a short time open an office in Toronto for the extension of their business. This is an institution that wants the consideration of all steam engineers, as they aim to give a technical education in engineering to all who will study. For starting as they do at arithmetic, they are prepared to teach anyone who can read and write. No previous knowledge of the subject is required, and anyone who will study can learn. Two of their representatives, Geo. Carruthers and J. E. Taylor, have been in Toronto for some time, and are very much encouraged by the interest shown in the schools. Their address at present is 226 Jarvis street, and they will be pleased to answer any enquiries, personally or by mail, regarding the various courses taught. They have some 1,400 students in Canada, and will be glad to give the names and addresses of any of these for reference.

Marine News.

A. Nichols, of Carleton Place, has bought a steam yacht.

The Chateauguay and Beauharnois Navigation Company, Ltd., capital $9,100, has received a Quebec charter.

Wm. Thomson & Co. are negotiating for the purchase of a steamship of 5,800 tons dead weight to be ready for delivery in November, to replace the Arbela.

The steamer "S. L. Tilley" has come out of the Kingston dry dock, where she has been undergoing extensive repairs. She has started for the upper lakes.

M. J. Hogan, of Section 12, Soulanges Canal, has placed an order with the James Cooper Mfg. Co., Ltd., of Montreal, for three of the latest type Sergeant drills.

M. A. Cleveland, contractor, of North Channel, found that he has considerably more work than anticipated, and has put in three more Ingersoll-Sergeant drills.

The steamship Leuctra Company has applied for a New Brunswick charter to own and sail the steamer Leuctra; chief place of business, Rothesay, N. B.; capital, $160,000.

The engines have been placed in the new C. P. R. steamer Queen City, and carpenters are busy finishing her deck house and fittings. She will be ready for service in about a week.

The machinery has been taken out of the steamer Carleton at Carleton Place, Ont., and the hull is to be fitted up as a barge for carrying passengers in tow of the Commodore.

The steamer Macassa was run into recently by the Ella Merton, owned by Elias Rogers & Co. The Macassa had the front part of the upper deck and the wheel house demolished. The schooner suffered the loss of her sails and jib-boom.

The Harbor Commissioners of Montreal invite offers furnishing them with land suitable for the site of a dry dock. The land must be on the north bank of the River St. Lawrence, between the Sugar Refinery and the Longue Pointe church. Lots offered must have a depth of not less than 600 feet from the boundary of the harbor lands to the Quebec Turnpike road, the breadth required being about 600 feet.

C. Giguire, under contract with the corporation of Quebec, has just built a large pontoon for the Champlain market wharf, for $9,186. This pontoon, the third of the series of new ones for the market and ferry boats, plying to the city wharf, is like the other two which were built in 1896 and 1897, 120 feet in length, 40 feet broad and 8 feet high or deep, conformably to plans and specifications prepared by C. Baillairge, city engineer, and under his superintendence and that of Foreman Verrault.

The K. M. T. & T. Co. and the Lake Bennet & Klondyke Navigation Co., have amalgamated, at least so far as their transportation business is concerned. Hereafter the latter company will have charge of all transportation matters, the steamer Amur, owned by the K.M.T. & T. C., being run by them in connection with their river steamers Oro, Nora and Flora, plying between Dawson and Bennett. The K. M. T. & T. Co. taking the offices in the Five Sisters Block and the Bennett Lake & Klondyke Company removing to the Government street offices.

The Esquimalt Marine Railway, Ltd., has sold out the plant and ship building business to a company which has been formed under the name of the British Columbia Marine Railway Co., Ltd. The new company, which has been incorporated with a capital of $200,000, has taken over the business as a going concern, the sale dating from July 27th. In addition to the large plant at Esquimalt which is capable of handling ships up to 2,500 tons, the new company intends to put up a smaller plant in the inner harbor for handling smaller vessels and will extend its business too to Vancouver, where it has already secured a site.

The new slip docks at Port Stanley, Ont., the contracts for which were awarded by the Lake Erie & Detroit River Railway Company late in May, will be completed and ready for use in a few days. The contracts called for their completion on Aug. 1, but unavoidable delays prevented their being finished in that time. The docks are being constructed immediately to the west of the light-house piers, and with the tracks and grading of the approaches, they will cost in the neighborhood of $55,000, the estimated cost of the docks alone being $45,000 and of the approaches $10,000. The contractors are the Hamilton Bridge Company for the iron work, and Babcock & Flook, Windsor, Ont., for the woodwork.

Railway Matters.

The new I. C. R. station at Moncton, N. B., was opened to the public, August 1st.

Trains are now running on the New York and Ottawa Railway between Ottawa and Cornwall, Ont.

Track laying on the Swan River extension of the Dauphin railroad is now going on, about 35 miles of grade being ready.

The new Grand Trunk offices in Montreal are to be a magnificent structure, the largest railway offices in the world. R. A. Waite, Buffalo, is the architect.

Mackenzie & Mann let to E. F. Farquhar, Toronto, the first 25 miles of work on the Ontario & Rainy River Railway. Locating parties are already in the field. Thomas White is chief engineer.

At a recent meeting of the Board of Directors of the Canadian Pacific Railway Company, dividends of 2 per cent. on the preference stock and 2 per cent. on the common stock for the half year ended 30th June last were declared, payable 1st October.

It is stated that the proposed railway from Brandon to Deloraine will be built this year, with a spur to the coal district south of Deloraine, where it is said a plant for mining coal will be put in.

Casper Braun, contractor, Berlin, who erected the G. T. R. depot in that town, has been asked by the Grand Trunk authorities to tender for the erection of a large round-house at Sarnia, to house 30 engines in.

The Brandon Southwestern Railway survey party has been gradually working its way north to Brandon, and has now reached that town. It is expected that the road will connect with the Great Northern at Bottineau, U. S.

With a view to completing the double track on the Montreal and Brockville section the Grand Trunk Railway authorities are at present engaged in widening the bridges at St. Annes and Vaudreuil, in order to place an additional track on each.

Work is progressing satisfactorily on the Restigouche & Western. A large force of men is employed under C. L. B. Miles, engineer in charge. It is expected that ten miles of rails will be laid early in October, and a second ten miles graded The first sod was turned August 12th.

The Brotherhood of Locomotive Firemen will, this month, celebrate in Toronto its twenty-fifth anniversary, and the sixth bi-ennial convention, beginning on the 12th. The Locomotive Firemen's Magazine has issued a handsome illustrated supplement showing a number of views of Toronto and portraits of the officers.

Application will be made at the next session of the Ontario Legislature for an Act to incorporate the Haliburton, Whitney & Mattawa Railway, to construct a railway from a point at or near the present terminus of the Grand Trunk Railway at Haliburton, to a point on the Ottawa, Arnprior & Parry Sound Railway, at Whitney, Ont., and in a northerly direction to Mattawa on the Ottawa River, with power to equip and operate it by steam or electricity.

The Grand Trunk Railway is making considerable additions to its rolling stock at the present time. It has just received from the Pullman Company twenty passenger coaches, which will be used on the western division of the road. Mammoth engines are being specially purchased to haul these new coaches. The company is now busy building 500 box cars in its shops at Detroit, and also 250 new stock cars.

E. C. Walker has been elected president and managing director of the Erie & Huron Railway, S. A. King vice-president, and J. H. Walker treasurer. John Forman remains secretary The following appointments have been made in the office at Walkerville: William Woollyatt, general superintendent and traffic manager; A. Leslie, accountant and auditor; J. H. Coburn, solicitor; Owen MacKay, engineer; S. Austin, mechanical superintendent; H. Morris, road master.

The Sooysmith Co. finished pier No. 8, the last of their work in connection with the Cornwall bridges of the O. & N. Y. Railway, last month. In less than seven months' work time ten piers, averaging about 1,000 yards of masonry in each, and four concrete abutments have been built, and with the single exception of the killing of Johnston by the falling of a tower, not the slightest casualty has occurred, nor a man been sent to the hospital.

W. T. Jennings, C. E., engineer of the James Bay Railway Commission, has returned to Toronto after making a preliminary survey of the Temegami & Wahnapitae districts to the Height of Land, having made a canoe journey of 700 miles. Mr. Jennings sent Mr. Sankey on to James' Bay to examine the bar at the mouth of the Moose River, and to report on the possibilities of constructing harbors on the south shore of James' Bay. Mr. Sankey is expected back as we go to press, and Mr. Jennings' report will be awaited with interest.

An important railway deal was closed Aug. 20th, when the Toronto General Trusts Company, representing the estate of the late John Leys and other trust interests in their keeping, negotiated the sale of the Port Arthur, Duluth & Western Railway to Mackenzie, Mann & Co., for a price said to be in the neighborhood of a quarter of a million. It is understood that it is the intention of Mackenzie & Mann to extend the

road forty or fifty miles into Minnesota to connect with the railway systems of the Northwestern States. It is also intended to connect it with the Rainy River Railway, a charter for which Mackenzie & Mann have secured and on the construction of which they are now working.

Mining Matters.

A 30-barrel oil well has been struck on the farm of F. W. Smith, Dunwich, Ont.

It is said that a valuable deposit of copper has been discovered at Wickham, Que.

A placer strike has been made on Rover creek, near Nelson, B. C., and many claims are being staked out.

The Libbey mine, Brookfield, N. S., cleaned up in July over 350 ounces of gold aside from the concentrates.

There is a report that gold in paying quantities has been found near Pinmaukin, on the head waters of the Rivers Shipshaw and Bersiamites, Labrador.

A natural gas well has been struck on the farm of Jacob Smith, near Ryckman's Corners, Ont. James Marshall, Barton, Ont., is the owner of the well.

The Nova Scotia Steel Co. has an order for 70,000 tons of iron ore from a German smelting company. The ore will be shipped from the Belle Isle mine.

Very rich mica has been discovered in the neighborhood of Kazabazua, Ottawa county, Que. The mine is turning out mica large enough, it is said, to cut 14x22 inches.

It is reported that a seam of anthracite coal has been located at Macadam's Lake, about 15 miles from Sydney, C. B. Dr. Gilpin gives an opinion that is favorable to the find.

The Trail Smelter, Trail, B. C., is increasing its boiler plant and has placed an order with James D. Sword, representing the James Cooper Mfg. Co., Ltd., Montreal, for another 80-h.p. boiler, to be added to the present battery.

The Hall mines, Ltd., Nelson, B. C., is re-equipping its tramway line with a complete new set of buckets, and has placed the order with James D. Sword, of the James Cooper Mfg. Co., Ltd., for 810 buckets. Delivery is to be made within eight weeks.

The James Cooper Mfg. Co., Ltd., is now erecting for the Whitewater Deeps Mining Co., Whitewater, B. C., complete 10-drill Ingersoll-Sergeant air compressor plant of the belt driven type, and installing Pelton water wheels with half a mile of converse lock-joint pipe and a mile of air line pipe.

It is said that the United States prospectors who are boring for oil at Lake Ainslie, C. B., have reached a depth of 1,600 feet, and were compelled to desist for want of further appliances to work at that depth. It is reported that the indications continue to be favorable and numerous as to the presence of petroleum in this neighborhood.

The Council of the Canadian Mining Institute has decided to hold the next meeting of the members at Nelson, B.C., early in October. Although it is yet too early to indicate a programme, we understand that already a number of papers have been promised, among the writers being: W. Blakemore, Crow's Nest Coal Co., Coal Creek; Wm. Braden, M.E., Pilot Bay; J. G. Gwillim, M. E., Sloean City; H. Percy Leake, M.E., Revelstoke; J. L. Parker, Rossland; O. E. S. Whiteside, M.E., Anthracite; H. A. Guess, Keewatin, Ont.

The Bannockburn, Hastings County, Ont., mine has just placed an order with the James Cooper Mfg. Co., Ltd., for a 30-horse power Lidgerwood hoisting engine with necessary boiler, pump, etc. This firm's erecting engineer has just returned to Montreal after completing the installation of a plant for the Regina Canada Gold mines, Ltd., Rat Portage, Ont. This consists of a 15-drill cross compound condensing Ingersoll-Sergeant air compressor, battery of boilers, ten drills, etc. Secretan & O'Boyle, Rat Portage, Ont., have increased their plant by ordering through the James Cooper Mfg. Co.'s Ltd., agent at that point, Ingersoll-Sergeant drills.

The Chatham Oil Company are boring three new wells at Thamesville, Ont. The large well struck by this company some time ago is still pumping fifty barrels per day.

The Noble Five Mining Co., Sandon, B. C., has just installed a new 7-drill compressor plant supplied by the James Cooper Mfg. Co., Ltd., Montreal, together with 1½ miles of pipe line and necessary accessories for the plant.

The Dufferin mine, Salmon River, N. S., plant is now running at its full capacity. It consists of an Ingersoll-Sergeant 15-drill cross compound condensing compressor, one 40-horse power and one 50-horse power Lidgerwood double drum double cylinder hoisting engine, battery of boilers, complete complement of drills, mountings, etc., all supplied by the James Cooper Manufacturing Co., Ltd., Montreal. This enterprising firm has received an order from the North Brookfield, N. S. Mining Co., for two more hoisting engines, one to increase the present plant, and one for new property that is being opened up. The Broad Cove Coal Co., of Broad Cove, C. B., has just installed an Ingersoll-Sergeant piston inlet air compressor, and complete coal cutting plant purchased through the Halifax office of the James Cooper Mfg. Co., Ltd.

The Rossland, B. C. branch office of the James Cooper Mfg. Co., Ltd., reports that its erecting engineer has returned from Anaconda, B. C., where he has been erecting a 12-drill compressor plant for the British Columbia Copper Co. The Athelstan Gold Mining Co., Rossland, B. C., has placed an order with J. D. Sword, representing the James Cooper Mfg. Co., Ltd., for preliminary plant, consisting of hoisting engine, boiler, pump, etc. The Liberty Mining Co., with headquarters at Rossland, B. C., has installed an Ingersoll-Sergeant piston inlet compressor with full complement of drills, etc., having purchased this through the Rossland branch of the James Cooper Mfg. Co., Ltd. The B. A. Corporation, Rossland, B. C., reports that it has both compressors that were installed by the James Cooper Mfg. Co., Ltd., of 12-drill and 5-drill capacity respectively, now running, and development work will be proceeded with with great vigor. This company in the Great Western Nickel Plate, West Le Roi and Josie is operating 19 Ingersoll-Sergeant drills.

The Messrs. McGregor's attempt to work their property at Fifteen Mile Stream, N. S., open cast or quarry fashion, has had to be abandoned. The quartz which it was expected to strike was not met with, and that crushed bore so little gold that it would be a loss to work. This is a disappointment after the very heavy outlay of late. So complete are the arrangements at this mine, and so excellent the machinery, that quartz in larger leads yielding a dollar's worth of gold to the ton can be worked to advantage. But we are glad to learn that the disappointment of the owners soon gave place to satisfaction. A shaft was planned to be sunk a depth of a hundred and fifty feet, at a distance of fifty feet or so from the open cast. At that depth paying quartz was expected to be met with. The shaft, however, had not gone twenty feet when it was found the large lead showed gold all round. Besides the quartz from this shaft other quartz will be mined from what is known as the 'Orient' mine, which after being idle for a long time has been pumped out. From these two shafts it is expected sufficient material will be obtained to keep the fifty stamps fully employed. The cable road built for the open cast can be utilized in taking one from the new shaft.

Electric Flashes.

A company of American capitalists talk of utilizing the water power of the Jacques Cartier river for electrical purposes.

The promoters state that the necessary capital has all been subscribed for the power development at Fenelon Falls, Ont.

The Electric Co. of Windsor, N.S., has ordered a 100 horse power, Robb-Armstrong engine from the Robb Engineering Co.

Carmen O'Dell, of Annapolis, N. S., is increasing his electric lighting plant by the addition of a 50 k.w. "S.K.C." Generator.

The Benallack Litho. & Printing Co., Montreal, has ordered from the Canadian General Electric Company, one of its latest type motors.

The Nelson, B. C., Electric Light Co. has sold out to the municipality for $35,400.

The Metropolitan Railway Company, Toronto, is now extending its line to Newmarket, Ont., which it is expected to reach by Nov. 1st.

The Hamilton smelting works will be fitted out with electric lights soon. The company will put in ten arc, and fifty incandescent lights.

The Canadian General Electric Co. has received an order from the corporation of New Westminster, B.C., for one of their 150 kilowatt monocyclic alternators.

The Hamilton Cotton Co., Hamilton, Ont., has decided to light its mills with electricity, and has placed an order with the Canadian General Electric Company for one of their 40-k.w. direct connected generators.

The West Kootenay Power & Light Company, Rossland, B.C., is rapidly extending its business, and for a recent extension has ordered from the Canadian General Electric Company three large feeder panels and two transformer panels.

The British Columbia Electric Railway Company of Vancouver, B. C., has found it necessary to increase its arc lighting plant, and has placed an order with the Canadian General Electric Company, for 1-125 light multiple brush arc dynamo.

R. H. Smith, Tilbury, Ont., whose plant was recently destroyed by fire, has placed an order with the Canadian General Electric Co., for an entirely new plant, consisting of two 15-k.w. standard Edison D. C. dynamos, and one 30-light arc machine. He expects to be running again in about two weeks.

The Kingston, Ont., Electrical Society has organized with these officers: C. Livingston, president; A. Chadwick, 1st vice-president; R. J. Dunlop, 2nd vice-president; R. H. Fair, Thomas Mills, D. E. Starr, John Carson, Joshua Knight, M. D. Curtis, G. McLean and Shibley, directors; Thomas Mills, treasurer, and J. P. Oram, secretary.

The Union Carbide Company, of Chicago, is arranging to greatly enlarge its plant at Sault Ste. Marie for the production of calcium carbide. The plant at Niagara Falls will be continued, but that at Appleton, Wis., will it is said, be discontinued. Twenty dynamos will be used in the new plant, and they have been purchased. These machines are single-phase, low-frequency alternators of 500 kilowatts each, delivering 2,500 amperes at 200 volts.

Herbert Webster, formerly of the firm of Webster and Hicks, Norwich, Ont., has secured a franchise for furnishing the town with electric light. The Canadian General Electric Company is supplying the entire electric equipment, which consists of a 700 light single phase alternator; marble panel switchboard, transformers, wiring. The corporation has contracted with Mr. Webster for the lighting of the streets by 40-32 c.p. incandescent lamps, operated in series.

The Montreal Cotton Co., of Valleyfield, P. Q., has placed a large increase order with the Canadian General Electric Company for induction motors, consisting of two 50-h.p., one 75-h.p., five 100-h.p. and one 200-h.p. When these are completed the cotton company will have one of the largest isolated electric power plants in America, the Canadian General Electric Company having already installed for this company, in generators and motors, a total of between 3,000 and 4,000 h.p.

The Canadian General Company has just closed a contract with the Lunenburg Gas Company, of Mahone Bay, N. S., for a 100 kilowatt three phase revolving field type alternating generator. This installation is to be used for the transmission of electric current, from a water power, situated about 9 miles from the town of Lunenburg, and will be operated without transformers at a potential of 4,000 volts. The company have also received an order for the wire to be used in the erection of the transmission line.

The amalgamation of the District Railway and Q. M. & C. Railway Companies is to be followed shortly, we understand, by the absorption into the joint concern of the Montmorency Electric Power Company. The shareholders of the Q. M. & C. Electric Railway Company will meet on the 13th inst. to ratify the bargain, and those of the Montmorency Electric Company a few days later. The trains of the Q. M. & C. will be run by electricity next year, and there will probably be an electric line along the Beauport road as far as Montmorency Falls.

L. E. Whitehead has resigned his position as superintendent of the Sherbrooke Street Railway.

The Peterboro Electric Light Co. is about to erect a modern power house at a cost of about $35,000.

The ratepayers of Barrie, Ont., have carried a by-law to raise $35,000 to build a municipal electric lighting plant.

An electric light system, arc and incandescent lights, has been installed by the C. P. R. at McAdam Junction, N. B.

Percy Domville has accepted the position of electrical expert for the city of Hamilton, Ont., in connection with the municipal lighting project.

A contract has been signed by the Canadian Niagara Power Company to supply light, heat and power to the Hospice of the Carmelite Fathers at Falls View.

A rumor is current that the Ottawa Street Railway Company has bought the Ottawa and Gatineau Valley Railway, and will convert it into an electric road.

As the people of Perth, Ont., defeated the Lanark County Electric Railway bonus by-law, there is now a scheme on hand to connect Lanark with Carleton Place.

S. C. Drummond, representing the British Electric Traction Co., of London, Eng., has applied to the Nelson, B. C., town council for a charter for an electric street railway.

There is talk of connecting the Niagara Central Railway with an electric road and extending it from St. Catharines to Port Dalhousie, Ont., and perhaps Beamsville, Ont.

L. E. Whitehead has resigned his position as superintendent of the Sherbrooke Street Railway. R. R. Smith, recently of Worcester, Mass., will assume the duties of superintendent.

A generator at the London, Ont., Electric Company's power house was burned out by the storm, Aug. 16th, and as a result power could not be supplied to a number of factories for a short time.

The ratepayers of Campbellford, Ont., have voted a by-law to raise $8,000 for the construction of a new incandescent light system over the entire village, to replace the one in use at present.

The Fisher Equipment Company of Chicago, manufactures electrically driven auto-cars, of which one known as a coach delivery wagon is now the property of the Robert Simpson Co., Toronto.

The Rat Portage Lumber Co. has fitted a motor to the car which supplies the planing mill and sash and door factory with lumber from the yards, and now has the first electric railway in Rat Portage, Ont.

The Jacques Cartier Pulp and Paper mill, Point Rouge, Que., has arranged to light the new pulp and paper mills by electricity. The order for the plant has been placed with the Royal Electric Co. and is to be installed immediately.

The Shawenegan Water and Power Company has advanced sufficiently with its plans for the installation of a plant capable of developing 100,000-h.p. to be enabled to call for tenders for the construction of the headrace, excavation for the wheel pits, etc.

The municipal ownership idea has apparently not swept Hamilton. A proposal to purchase the street railway has been rejected by the ratepayers by a vote of 264 to 2,043. Hamilton has at present an arrangement with its street railway that yields the city $16,000 a year. This coupled with the fact that only part of the voters were allowed to vote may account for the result.

A meeting of the shareholders of the Eastern Townships Light, Power and Carbide Co., was held at North Hatley, Que., a short time ago. The new company has been formed for supplying the electric light system to the villages of Waterville, Compton, Eustis, and North Hatley, and also to manufacture calcium carbide. The capital stock of the company is $50,000. At a subsequent meeting of the directors the following officers were elected: President, J. A. Gordon, North Hatley; vice-president, N. N. Walley, Sherbrooke; general manager, Dr. C. J. Edgar, Sherbrooke; secretary-treasurer, O. Roy, Montreal; assistant secretary-treasurer, Joseph Goodwin, North Hatley; solicitor, Mr. M. F. Hackett. The company has purchased the electric plant formerly owned by Edgar & Roy, and propose extending the business.

A charter for a railway to be operated by steam or electricity from Sault Ste. Marie to Michipicoten has been applied for.

The Stevens Mnfg. Co., London, Ont., has closed the electrical department of its business and will confine itself in future to agricultural machinery, etc.

The Royal Electric Co. is installing in the sub-station of the Cataract Power Co., on Victoria street, Hamilton, a 30-h.p. S. K. C. induction motor, which is to be used in driving the fans for the air blast transformers.

Electric light and gas fixtures are beautifully illustrated in catalogue No. 20 issued by Munderloh & Co., Montreal, wholesale electrical supplies and dealers in incandescent and arc light plants and electrical goods generally.

The Waterous Engine Works Co., Ltd., Brantford, Ont., is adding to its shop capacity, and requiring more power, is installing a 30-h.p. induction motor from the Royal Electric Co., which is to be operated from the alternating current lines of the Brantford Electric & Operating Co. This makes over a 100-h.p. in S. K. C. motors now operating in Brantford.

The Windsor Electric Light & Power Co., Windsor, N. S., is enlarging the recently installed electric lighting plant. It is adding one 100-k.w. and one 40-k.w. S. K. C. generator, with an additional complement of transformers and material. The S. K. C. apparatus and transformers are from the Royal Electric Co.

J. T. Ayers, of Lachute, has secured a franchise from that town to furnish incandescent electric lights. For this purpose he has placed his order with the Royal Electric Co., for a 100-k.w. S. K. C. generator, and the necessary transformers and material for the construction of the entire plant. The new plant will be driven by a water power situated about two miles from the center of the town.

The Ontario Telephone and Switchboard Construction Company, Ltd., has received an Ontario charter to manufacture telephones and other electrical appliances; capital $75,000. The incorporators are: R. Fox, T. H. Smallman, F. B. Leys, T. H. Purdom, R. A. Bayly, J. Labatt, M. Masuret, J. Milne, J. D. Wilson, M.D., and J. R. Minhinnick, London, Ont.; and R. H. Evans, H. C. Walters, Detroit, U. S.

The fourth of the 2,200-k.w. S. K. C. generators was set up in the Chambly Electric Manufacturing Co.'s power house at Richelieu, Que., a few days ago, and there are now ready for operation over 10,000-h.p. These are the largest electrical motors ever built in Canada, and the largest excepting Niagara Falls, that has ever been built. Electricity is no longer in its infancy, neither is Canada behind in the development of the science.

The Dundas Electric Light Co. has received a franchise from the town of Dundas, Ont., to furnish incandescent lights throughout the town, and also a contract for the street lighting. Both systems must be in operation by the first of November, 1898. The entire electrical equipment, consisting of a 50-k.w. S. K. C. two-phase generator, with 500 lights capacity in transformers, and all the necessary wire and material, is to be supplied by the Royal Electric Co., and the plant is to be installed at once. Geo. H. Harper, Dundas, will be manager of the new company.

Friday, the 26th August, 1898, will be memorable in the annals of electricity in Canada, being the day on which the Cataract Power Co., Hamilton, Ont., turned the first current on to the long distance transmission line between Decew Falls and Hamilton. The water was let into the fore bays and pipe line at about 3 p. m., and at 3.30 p. m. the hydraulic plant, consisting of two 1,500-h.p. waterwheels, and the electrical plant of two 1,000-k.w. S. K. C. generators, were turned over, the switch closed and the power sent to Hamilton, a distance of 35 miles, where it was utilized for lighting arc and incandescent lamps, and also for driving a 40-h. p. S. K. C. induction motor. The incandescent lamps in the sub-station, in Hamilton, were very artistically arranged in the form of a large star and maple leaf, and were kept lighted until far into the night. The plant will be started up permanently in a few days.

At the Royal Electric Company's fourteenth annual meeting the reports presented were considered to be satisfactory. The gross revenue was shown to have been $955,826; expenditure $636,057; interest and fixed charges, $42,609; net profit, $277,160. Four quarterly dividends have been declared, of two per cent each, equalling $120,000. Ninety thousand dollars was charged to profit and loss for reduction of assets in patents; $25,000 for depreciation of plant, and $31,992 for other reasons. It was shown that the company last year made eighteen and one-half per cent. on invested capital, as compared with sixteen and one-half per cent the preceding year. A dividend of eight per cent has been paid yearly since 1891. The company now employs 600 hands, and its wage bill exceeds a thousand dollars a day. There was expended in material last year $400,000. Business in new customers has increased fourteen per cent., and for lights, sixteen per cent. The addition of a new plant has resulted in an economy of coal consumption of 5,300 tons of coal; as compared with the figures of two years ago. The old board of directors were re-elected, namely: The Hon. J. R. Thibaudeau, president; D. Morrice, vice-president; F. L. Beique, Allan R. Macdonell, H. S. Holt, J. A. L. Strathy, A. Brunet, Edwin Hanson, Robert Cowans and W. H. Browne, general manager.

Personal

James Quigley, Kingston, has been appointed chief engineer of the Deaf and Dumb Institute, Belleville, Ont.

George Bottomly, aged 25, was killed recently by an emory wheel bursting in his father's mill, Halifax.

John White, for nearly a quarter of a century foreman in MacGregor, Gourlay Company's foundry, died in Galt, Ont., a short time ago.

James D. Banks, Toronto, formerly engineer on the steamer Ada Alice, committed suicide a short time ago by inhaling gas, and thus causing asphyxiation.

Louis Simpson, Belleville, Ont., an engineer on the Grand Trunk, was struck by the pilot engine in the Brockville yard, August 2nd, and instantly killed.

C. W. Taylor, vice-president and general manager of the Canada Carriage Co., Brockville, died last month, much to the regret of a large circle of friends.

F. R. F. Brown, late mechanical superintendent of the I. C. R., is said to have fallen heir to $50,000 through the death of a relative in England.

George Kelly was caught in a belt in the George Gillies Company belt factory at Gananoque, Ont., and was thrown over the shaft and instantly killed.

Dan. McAnnany, contractor, of St. Boniface, Manitoba, is dead from the result of an accident on the Crow's Nest railway construction, where he had a contract.

Frank Travers, a steam-fitter, was accidentally killed a short time ago at the Mimico asylum, while engaged in repairing the heating apparatus. A radiator fell upon him.

A. P. Coleman, geologist for the Ontario Government, has gone to England to attend the British association at Bristol. He will read a paper upon the inter-glacial period.

Hector McLean, president of the International Brick and Tile Company, died at Bridgetown, N.S., a short time ago. He was one of the best known men in Annapolis county.

W. Griffith, engineer at the electric light station, Carleton Place, Ont., has resigned his position to go firing on the Parry Sound Railway. J. Bennett succeeds Mr. Griffith, and Geo. Fife takes Mr. Bennett's place.

William Madden, Westville, N. S., who has held the position of deputy inspector of mines in Nova Scotia for many years, has been appointed, by the Dominion Government, one of the mining inspectors in the Yukon.

A. H. Harris, the late traffic manager of the Intercolonial Railway, has been appointed general traffic agent of the Fitchburg Railway Company, in charge of all traffic affairs in the Dominion, with headquarters at Montreal.

Percy Girouard, son of Hon. Mr. Justice Girouard, of the Supreme Court of Canada, has been appointed chief in the Egyptian railway system at a yearly salary of £2,000 sterling, by the Imperial Government.

James Hutcheon, city engineer, Guelph, Ont., was up some 50 feet in the old rolling mills to superintend the fixing of a block and tackle to take down railroad rails, when he caught hold of a loose board and fell to the floor below, but fortunately escaped serious injuries.

George Coates, son of John Coates, president of the Ottawa Gas Co., blew off his arm by the accidental discharge of a gun and died in a few hours. The accident happened at Shaganaga Lake, near Hunter's Island, Algoma. Mr. Coates was 21 years of age, and a student in the Kingston, Ont., School of Mines.

William Cooper, contractor of Clinton, Ont., fell about thirty feet from a scaffold on Aug. 17th, and died in about 20 minutes. Mr. Cooper was one of the best known men in the county of Huron and very highly respected. He leaves a widow and family, one of whom is John A. Cooper, editor of The Canadian Magazine and secretary of the Canadian Press Association.

Wm. Fraser, engine driver on the Springhill and Parrsboro Railway, was instantly killed at Springhill station, recently. He went under the locomotive to do some work and while under accidentally struck the brake with his hammer. The throttle of the engine had been left open, and the striking of the brake released the wheels of the engine, which gave a jump and went about eight feet along the track.

W. F. Robertson, the new provincial mineralogist of British Columbia, graduated in 1880 with honors in natural science from McGill. His first practical work was at the Capleton copper mines in Quebec province. He afterwards went to Pennsylvania as superintendent for the Chemical Copper Company, and next assistant in New Jersey to H. M. Howe at the Orford Copper Company. Mr. Robertson after this became superintendent to James Douglas' copper works at Phoenixville, Pennsylvania, and after some time there went back to the Orford Copper Company as engineer and put up their large works for that company, which, it may be mentioned, smelts the Sudbury nickel ore. Mr. Robertson later on was engaged as engineer of the Spring Hill collieries in Nova Scotia. He then went to Spain in the employ of the Minas Sotiel Coronada, and after returning to this continent put up a large smelter for the Osceola Smelting Company in the Lake Superior district, and had also charge of the smelting works at Great Falls for the B. & M. Co. Having gone back to the Orford Company as superintendent, he finally settled down in New York in private practice as a consulting mining engineer and has given reports on mines in various parts of the continent.

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

(Continued from last issue).

All buildings over 125 feet high should be provided with 4 inch, or, better still, 6 inch vertical pipes, with Siamese connections at the street, for the use of the fire department, extending to the roof, with hydrants at each story and on the roof. This would save the time of carrying hose to upper floors—a difficult task in the case of high buildings. Ample tanks of water should be provided on the roof, supported by protected iron beams resting on iron templates on the brick walls, to supply the building's inside pipe system for fire extinction, and secure pressure by gravity or by some other method constantly operative, especially on holidays and at night. Stone templates should not be used, and care should be taken to secure strong supports, so that, in the event of fire below, the tanks will not come crashing through the building to destroy it and endanger the lives of firemen. Two such disasters in "fire-proof" buildings within a year show how true is this proposition. Tanks in the basement, under air pressure are also a great advantage, and recent invention has perfected them to the point of reliability. Fire Marshal Swenie, of Chicago, urges that standpipes should not be less than 6 inches internal diameter, and that a check valve should be provided, so that when steamers are attached, their force will be added to that of the local pumps. Each floor should have hose connections with the standpipes, and sufficient hose to reach to the most remote point of the floor above, and this hose should be frequently inspected to see that it is in order. He recommends that a code of signals, by which communication can be established between the firemen and the engineer of the building, is essential.

All high buildings should have constantly present, night and day, some competent person understanding the elevator machinery, fire appliances, etc., so as to aid the firemen in reaching the upper levels; and there should be sufficient steam in the boilers, at all times, to run one elevator.

Marble, slate, and other stones are certain to disintegrate or crumble when subjected to the joint action of heat and water. For this reason 90 per cent. of the staircases in modern "fire-proof" buildings would be found utterly unreliable in the event of fire, either for the escape of the inmates or for the use of firemen—a serious consideration. Stone treads are usually let into iron rabbet frames, and as these stone treads would give way in case of fire, it would be impossible for a person to find a footing on the stairways; 2 inch oak treads might actually last longer; but a safer staircase would be one the framework of which is of iron, the tread having an iron web or gridiron pattern, the interstices or openings of which should be small enough to prevent the passage of a foot, underlying the stone or slate, so that if the stone tread should disintegrate, the staircase still remains passable. It is possible to have the supporting tread of open work cast iron in an ornamental pattern, which, in relief against the white marble tread resting on it, would present a tasteful appearance from the underside or soffit of the staircase, with this great advantage, that in the event the action of fire and water should pulverize the marble or slate tread, it would still afford a safe support for the foot. It is generally supposed that it is not necessary to be careful as to stone treads in buildings occupied solely for offices separated in "fire-proof" hallways in which, it is claimed, there is nothing to burn; but in the case of one large "fire-proof" building of this kind in New York, I found the space under the staircase in the basement story was used to store the waste paper rubbish of the building—material particularly likely to cause a fire by concealed matches, oily waste, cigar or cigarette stumps, etc., and to make a lively and quick fire, quite sufficient to destroy stone staircase treads. Even where there is no combustible material in the hallway, if the staircase is near windows, stone treads may be destroyed by exposure to burning buildings and by the combustion of window frames, dadoes, and other wooden trim.

No building should exceed in height the width of the street on which it is located, from the view point of light and health; nor, in any case, in excess of 95 feet for mercantile occupancy, nor a height in excess of 200 feet for office occupancy.

It should be remembered that merchandise, furniture, etc., are combustible, no matter whether located in "fire-proof" buildings or in ordinary buildings. This obvious fact seems generally to be ignored. In fact, combustible material will sometimes be more effectually and thoroughly destroyed in a "fire-proof" building than in an ordinary building, since the early collapse of the latter may smother the fire and effect salvage, whereas "fire-proof" floors support the contents of the former, and distribute them so that they are more certain to be destroyed.

Enclosing walls should be of brick, the brickwork of the lower stories especially, if not of all, being laid in cement mortar. In fact, the specifications for a building in the compact part of the mercantile section of a city, ought to be drawn in contemplation of the possible cremation of its contents, and the generation of heat considerably greater than 2,000 degs. Fahr. The heat of a wood fire is from 800 to 1,140 degs.; charcoal, about 2,200 degs.; coal, about 2,400 degs. Cast iron will melt at between 1,900 and 2,800 degs.; wrought iron, 3,000 to 3,500 degs.; steel, 2,400 to 2,600 degs.; and if an architect should be required to draw specifications for a building adjoining others, with the knowledge beforehand that its entire contents, from cellar to roof, were to be totally consumed, and he were under a bond to pay damages to surrounding property, he would not be more severe in his exactions than should a building law protecting neighborhood rights in the enjoyment of property; for a mercantile or manufacturing building sometimes generates a greater heat in combustion than a smelting furnace. It is hardly necesary to deal with the foundations of buildings. The question is an engineering problem which hardly requires suggestions from a fire standpoint, and I shall not deal with it here, other than to touch again upon the im-

portant point of not having wrought-iron or steel columns in the cellar or basement, where moisture and gas conditions would increase the danger of rust. These, as already stated, should be of brick, the lower stories laid in cement mortar, not less than 16 inches thick at the top of the building and increasing 4 inches in thickness for every 25 feet in height to the bottom. This would require a 44 inch wall at the grade for a 200 foot building. The thicknesses here recommended are for buildings not exceeding 100 feet in depth. If they exceed this depth without curtain or cross walls, or proper piers or buttresses, the walls should be increased in thickness 4 inches for every additional 100 feet in length.

Brick is the best known resistant of fire. Stone yields readily to the combined effect of heat and water, and even terra-cotta or burned clay tile cannot be regarded as a perfect substitute for hard-burned brick. Under no circumstances should the iron framework of a skeleton building be incorporated in thin enclosing walls. No wall that has not a cross section sufficient to support itself without the ironwork should be allowed, aside from the importance of having it thick enough to prevent the passage of hot air from an adjoining building. Curtain walls for enclosing walls supported by the longitudinal members of skeleton construction are objectionable; they are liable to be buckled out by the expansion of the framework. The great trouble with modern "fire-proof" structures is, that while the separating "fire-proof" floors tend to prevent the passage of flame from one story to another, the enclosing walls are often insufficient to prevent heat from igniting the contents of an adjoining building, so that what is gained by preventing the spread of fire vertically is lost laterally. It should be borne in mind that the thickness of walls herein recommended is not for carrying capacity as bearing walls. Thinner walls would answer for that purpose. It is intended to confine the heat generated by a fire, and should be required in the compact portions of cities, where every man should be compelled to build with reference to the safety of his neighbor.

Architects and builders generally seem to have in mind only the carrying capacity of walls, and to lose sight of this important fact. As the contents of a mercantile building and its floors burn, they sink to the bottom, where enormously high temperatures are reached, and it is for this reason recommended that walls should increase in thickness as they approach the bottom, on the same principle that the walls of smelting furnaces are thicker at the bottom than at the top. It is the generally accepted opinion that a 12 inch brick wall will prevent the passage of fire, but a much thicker wall will fail to confine the heat of a burning building on the first floor particularly, sufficiently to prevent the ignition of combustible merchandise or other material in an adjoining building. In a fire which occurred in Boston, several years ago, combustible material was ignited through a 3 foot wall, which became so hot as to thus conduct the heat into the adjoining building.

I do not believe "skeleton construction" so-called should be permitted for stores, warehouses, or manufactories in cities, as the walls are not thick enough to confine the heat of burning merchandise. In some of our Western cities, Detroit, Chicago, etc., the practice is growing of using hollow tiling, bonded like ordinary brickwork, 12 inches thick, for enclosing walls, instead of brick, the exposed steel frame being protected by terra-cotta slabs about an inch thick. The Leonard building, in Detroit, destroyed by fire October 7, 1897, was an example of the great danger of this style of construction. It was ten stories high, and as fast as the columns or wall girders were warped by the heat the tiling dropped out like loose bricks, leaving the entire structure after the fire a ragged cage-work of iron with very little of the tiling on the enclosing walls and none of the floors intact. The contents were, of course, totally destroyed.

Bond stones should not be allowed in piers, especially in the cellar or basement, or in piers vital to the building or carrying great weights. Stone yields readily and quickly to the combined effects of water and heat and, disintegrating at its edges, gradually releases the bricks above it, so as in time to destroy the integrity of the pier. Bond stones are employed by the mason to steady his work. A green brick pier while being laid is frequently unsteady, and a bond stone enables him to progress with his work by steadying all below it so as to receive new courses of brick. In all cases the bond should be a cast-iron plate. If the plate should be cast with holes through it about 1½ inches in diameter, so that the mortar and cement can thoroughly incorporate the plate with the masonry above and below, it would be an improvement. Wrought iron is liable to rust and should not be used. Where bond stones are used in the outer walls of buildings they are less objectionable, but for inside piers they are so dangerous that they ought to be prohibited by law. It not infrequently happens that a building of otherwise admirable construction has its weakest point in the cellar, where a stone pillar forms the basis of support of the entire line of columns through the building. In case of fire and the application of water these stone pillars, no matter how substantial, whether single monoliths or stone blocks, will rapidly disintegrate and bring down the entire structure; and inspectors should carefully examine, especially in the cellars, for such construction. After the great Boston fire, granite piers were shovelled up and carted away like so much sand. It is quite a common practice, but a most dangerous one, to employ single stone columns, often of polished granite, to support the centre of a long stone lintel carrying the wall over the ornamental entrance of a building. Such a column would surely yield to the effect of fire and water and perhaps let down the entire front. The vertical supports, columns, pillars, etc., as already stated, should be of cast iron, cylindrical in form, of liberal thickness, especially in the lower stories, thoroughly tested as to sand holes, thin places, etc. Cast iron columns should be round, and not square. In the former shape there is less likelihood of defects in casting, sand holes, etc, resulting in uniform sound thickness of the shell. The columns should be planed to smooth bearings, so that the entire system of columns, from the foundation to the roof, may be securely bolted together and form a continuous line with joints for expansion and without any inequalities of bearings. Under no circumstances should wedges or "shims"* be allowed. This most important matter is often neglected. The flanges and corbel brackets for supporting beams should be cast in one piece with the column and not depend upon rivets or bolts. Rivets, aside from the danger of shearing strains, are almost certain to rust to the point of danger. The beams should be riveted or bolted to lugs on the columns, however, as a tie between the side walls, holding the entire structure firmly and consistently together as one rigid whole and yet with play for expansion. Col. George B. Post, of New York, has devised a form of cast-iron cage construction consisting of pillars and floor beams, the members of which lock into each other without the use of bolts or rivets, forming a very rigid construction, and saving the cost of mechanics for bolt and rivet work.

(Continued in next issue)

—Gaseous fuel as a substitute for the direct consumption of coal continues to extend in England, state Matheson & Grant in a recent circular to the engineering trades. Not only are the waste gases of blast furnaces being more skilfully utilized than heretofore, but improvements and economies in the making of producer-gas from cheap waste coal at the collieries, encourages its use as power for gas engines, and in some cases as fuel for steam boilers. This change, if it continues to extend, will go far to solve the question of smoke prevention in iron manufacturing towns.

*Shims are pieces of slate or iron inserted to secure a true vertical, where the two surfaces have not been properly levelled or planed.

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PURIFICATION OF SEWAGE BY IRRIGATION.

BY W. M. WATSON.

There is a good deal of misconception with reference to sewage purification by irrigation. It appears natural to convey all filth and manure to the land from whence it came, and make the cycle of production and consumption complete, and probably on this ground the many scientists and public officials favor irrigation. But experience and discovery have shown that land can only act as a filter, that is, a place for the lodgment of micro-organisms, that live and do the work of cleaning the dirt from the sewage, thus bringing the fluid back to its former state of purity. To enable the microbes to do this, that able scientist, W. E. Adeney, proves that air must be supplied and properly distributed to every separate atom of sewage in the proportion of three parts of air to one of sewage. Air cannot possibly be distributed into all the particles of the soil of a farm or any other land to a greater depth than about one foot, and often less, and when sodden with water or snow very little if any atmosphere can penetrate. Many inventions are being tried to aerate even artificially made filters. The best yet known is to fill the filter quickly, allow it to stand for a given period, then slowly draw the fluid off. As the fluid settles from the filtrate air is drawn into the interstices between the small cubes the filter is filled with, in that way the micro-organisms secure sufficient oxygen to give them vitality. By another method porous pipes are placed among the small cubes of coal, coke, clinkers, or whatever material may be used to filter or separate the particles of sewage fluid and atmospheric air passed through them at a pressure of about four inches of water by a fan, so that a constant supply of air is conveyed to the interior of the filter and is distributed throughout during the time the sewage is passing through, and on that account the filters work continuously. It is obvious that land that cannot secure air except at the surface, therefore cannot form a lodgment for microbes that must have air to live. If there are no microbes then there is no purification, and a milk sieve would do just as good work as any land, or even any artificiai filter that cannot be supplied with air by some process or its equivalent (as some claim) of soda or similar chemicals. Arthur Turley, .C.E., inspector of English sewage disposal works, states on page 5 of his report for 1890, that where irrigation is adopted, either alone or in combination with some precipitating process, the foreign matter in solution in the sewage is frequently increased by salts washed out from the soil. German chemists have given much attention to this disadvantage attendant on land filtration. The Teltower Sea, a lake near Berlin, was fouled by the effluent from the noted Berlin sewage irrigation works. Professor Muller reports that during nearly six months of the year no vegetation takes place on the land, and in hard frosty weather the land will not act properly, and the sewage must be stored up in tanks. Dry earth exerts a strong purifying influence on fœcal matter, but has very little if any effect on the other ingredients contained in sewage which contain millions of dangerous bacteria. People go into ecstacies if they see a sewage irrigation land that appears to perform its work well, as they usually do for one year, and sometimes as much as four years, and the success is proclaimed far and wide.

It came to my knowledge that a sewage farm near Montreal was considered to be very near perfection, and on September 14th last I had the privilege of inspecting this farm at St. Lawrent College, St. Lawrent, a village near Montreal. The farm contained 1¼ acre or 6,000 square yards of land, raised by light soil to a level of over 20 inches above the natural ground line. The population served by this irrigation system was said to be 400 persons, the daily sewage was about 4,500 gallons, an average of 11¼ gallons per head, which would allow the very small amount of only three quarts of sewage to one square yard of land per day. This system cannot properly be called a sewage farm, it is really the land filtration system, because the soil is well underdrained by having a row of land tile pipes laid under the centre of each of the twelve bays or divisions which deliver the effluent after the sewage has passed through the land into the parish drain, this coupled with the fact that the land was raised with light porous soil makes it an artificial land filter. The surface appearance of the land is that of a checker board having twelve trenches cut across from the distributing channel to the opposite side and to cross trenches, each trench being about 15 inches deep. The irrigation land and necessary appliances were said to have cost $3,500, or an average of $8.75 per head of population. This is

exclusive of the sewage storage and collecting tank and the steam pump. This is a high price to pay for a system of sewage purification that can't possibly work efficiently during hard frosty weather, and that gives off a disagreeable and unhealthy odor each time the sewage is run onto the land.

The engine and pump send each day's collection onto the irrigation land in the space of about two hours, so that the land gets only two hours' work and 22 hours' rest and aeration daily, and it may also be observed that the small amount of only ¾ of a gallon of sewage to one square yard of land cannot make any serious effect on the light soil, and it will be quickly absorbed during the hot dry weather of summer. If it was possible for each town to secure a light porous land, well underdrained, and to allow their irrigation filters 22 hours' aeration each day, a bright, pure effluent would be the result for several years until the porous soil got fatty.

But not one town in ten can secure suitable land for sewage purification works, and if the land has to be properly prepared and underdrained so that it cannot possibly become waterlogged, then the cost is so high as to be prohibitive, because artificial tank filters can be built at about the same price that will do fifty times the amount of work, and work efficiently both summer and winter. It is next to impossible to efficiently aerate irrigation lands, and on that account they gradually become sick and clogged with injurious microbes, therefore, in time, they become utterly useless as did the irrigation system adopted at Berlin, Germany.

A week prior to inspecting St. Lawrent sewage works I was engaged to go to the Georgian Bay district and find out why a sewage works had become totally disabled and was discharging foul odors. This irrigation filter is very similar to the St. Lawrent one, but with more advantages, because it is built on high ground and can be clearly drained to a depth of over four feet.

The whole filter at the Georgian Bay was created by piling up gravel and sand inside of a wooden fence. It is only used in the four hottest months of the year, that is during the tourist season. The population using the irrigation filter when the place is full with guests is under 300, including servants. The size of this irrigation land is 80 by 45 feet, which is ample to purify the sewage discharged when the fact is taken into account that all the solid matter contained in the sewage is supposed to be extracted by settling tanks prior to to its being discharged over the irrigation filter, on the intermittent system of working 30 minutes and resting three hours, and at the rate of only 10 gallons per yard per day when working at the fullest capacity.

After working for only two months the pores of the filter got so clogged that no sewage would pass through it, the cause being that the sheet iron settling tanks were not large enough to give sufficient time for the solids to separate from the liquids and to prevent the manureal matter from passing over on to the irrigation filter, and when a filter becomes badly clogged or sick it is impossible to clean it except by putting the whole of the filtrate through a furnace, and bringing it to a red heat, or by turning it all over with a hand spade and spreading it out in thin layers exposed to the purifying influence of the air for a year.

The apparent success of the St. Laurent sewage works is delusive, for like all other similar irrigation works the soil will in time become sick and clogged, and proof is already to hand, for we were told that during this summer the underdrains have not collected any effluent, yet that during the corresponding period of last summer they did collect considerable, so the bottom and heavy portion of the irrigation land is already sick, and the sickness will grow until the light porous soil at the top is also contaminated. It must come to that state, because land will not continue to purify sewage unless it can be often and thoroughly aerated to the level of the underdrains, which is very difficult. Much stress was put on the fact that the crops grown on the land were abundant and proved the system a paying one, but if such light soil had got watered by clean rainwater of the same amount as the sewage supply the crops would have been equally abundant, and certainly more wholesome. That eminent medical authority, A. Parks, adviser to the British Government, in his book on Hygiene, written for the benefit of the British army, states that plants grown on land irrigated by raw sewage are unsafe to eat (see page 354). On pages 119 and 121 he proves that the atmosphere near all sewage irrigation farms is impure, and people living near are subject to enteric fever and other disorders, so that the surrounding land always must decrease in value.

THE MOTOR CARRIAGE INDUSTRY.

It is with satisfaction that we note the present condition of the motor carriage industry, as the business seems to have passed the dangerous stages. The period of booming is passing, and after an enormous expenditure of capital in valueless patents, unsound companies and empty advertising, autocar makers are acting upon ordinary business principles. France takes the lead, and already there is invested in the autocar business in that country the enormous sum of $150,000,000, while 2,000 men are constantly employed in the industry. This condition of affairs is due to two causes: First, the magnificent roadways in France, and secondly, the fact that the French peasantry are very hard-working and extremely frugal, and thus have an immense sum total of money always in reserve to invest in enterprises that have the virtue of novelty as well as the promise of success. Added to this is the fact that the leaders of French society have taken very kindly to the new pastime of "motoring," and large sums from private fortunes are being lavished upon the manufacture of motorcars of all descriptions. The Count de Dion deserves special mention in this connection. Twelve years ago he prophesied the wonderful development we are now witnessing in horseless carriages; and during all these years he has lavishly spent time, thought and treasure in supporting the inventive genius of his mechanical associate, M. Bouton. It is satisfactory to note that the daring and dashing enterprise of the rich Frenchmen are being rewarded by enormous business returns. One firm, Panhard et Levassor, in a single month recently took orders for autocars amounting to a quarter of a million dollars. M. Frankel, who designed a small tricycle carriage to sell at $400, in less than a month took orders for $40,000 worth. All the autocar shops in France are so crowded with orders that customers have to wait from six to fifteen months for their carriages. These factories are in nearly every case huge establishments employing several hundreds of men.

There is some activity in Germany and Belgium, but nothing is being done worthy of special mention. Crossing over to the British Isles there is a perceptible improvement in the autocar industry there. True, the hand of the promoter is visible in many of the schemes that are being exploited, and a great deal of experimentation is still being done; yet in various parts of England, especially in Coventry, and also in Scotland, praiseworthy efforts are

being made to get the business down to a commercial basis. The Daimler Motor Company, which works under the patents of a German inventor, seems to be taking the lead, but they have had some trouble recently in connection with a complaint by Henry Sturmey, the editor of The Autocar, in reference to the election of a novice as chairman of the board. The result has been the appointing of an investigating committee of three able persons, whose efforts, it is hoped, will result in good to the shareholders and the industry. Her Majesty's mails are being carried in some places by motor vans. The recent trials of heavy haulage autocars in Liverpool were a failure so far as new methods of propulsion are concerned, there being no entries of electric or hydro-carbon systems, and the steam vans, while showing structural improvements upon those of sixty years ago, have not yet overcome some of the inherent difficulties. In a recent issue we gave a full outline of the Liverpool trials. An American engineer, Hugh Dolnar, makes some caustic and critical comments on the exhibition, and it may be interesting to quote some of his conclusions. In an article in the Cycle Age, he says: "Such were the actual results of the Liverpool trial, the wagons in the hands of their builders showing that they had power enough to pull the loads over a bad road, it is true, but that otherwise they were wholly unsuited to any existing conditions of transportation now performed by the aid of horses. . . . . The heavy, self-driven wagon has not been built yet. It will be built, but no such absurd assertions that failure is success as are contained in the Automotor's silly editorial will make it come a day sooner. The situation calls for a calm consideration of facts and results obtained. In all mechanical operations the quickest way out is to recognize failures, and so be in a position to look for elements better adapted to meet actual conditions. None of these wagons shown at the Liverpool trial could do anything whatever towards city trucking, and it does not seem at all likely that any steam engine driven wagon will ever be found suitable for heavy work, loads of say from two to four tons, such as are commonly drawn on two-horse trucks. The heavy truck is a far more difficult problem than the four or six-passenger vehicle, and absolutely must have all four of its wheels driven, and must be able to place itself as quickly as a horse-drawn vehicle can be placed at the curb or on a crowded pier." In London the electric cabs are only partially successful. Recently there was a strike among the drivers, and one of them stated their grievances to be: numerous break-downs of the mechanism, for which the drivers had to pay although they were not liable; the slow speed of the cabs, thus reducing the drivers' margins; poor pay as compared with that allowed drivers of horse cabs. The matter was patched up after a few days by concessions from the company. The London electric omnibuses are not yet running. The real reason for this, as well as for the trouble with the electric cabs, we believe to be the lack of storage batteries that while lighter than those now in use will yet give off more power. The immense dead weight carried by the London omnibuses, each of whose batteries weigh about 1,600 lbs., adds enormously to the perplexities of the problem, and it is safe to say that until a lighter battery equipment is provided the solution will be far off.

In the United States the industry has made very little headway. As the editor of The Cosmopolitan—who two or three years ago gave a prize of $3,000 for the encouragement of the industry in the United States—remarked in an article published in his magazine last month, it is astounding that a people so progressive as the Americans should be so far behind France, and indeed England, in this industry. One explanation of this backwardness is found in the fact that the American roads are about as bad as they can be. Worby Beaumont, the president of the Society of Engineers of England, remarked to the editor of The Horseless Age, when on a visit to New York recently, that the American roads were the worst in the world, and he could quite understand why the horseless carriage industry had not made further progress there. Col. Pope, of bicycle fame, has spent nearly a quarter of a million dollars in exploiting electric equipment for carriages, and from his motor vehicle factory in Hartford has turned out several of the Pope carriages. Their price is $3,000, their weight about 2,500 lbs., and their carrying capacity only two persons, their running power only about 25 miles; and these limitations and conditions have prevented ready or rapid sale. Col. Pope is now exploiting gasolene with Hiram Maxim at the head of that department. So far, however, nothing striking has been produced. The Duryea motor carriage, of which so much was expected, has sunk into comparative insignificance. This carriage won about $8,000 in prizes at various races: but attempts to establish companies for its manufacture in New York and in Canada have proved failures, and the sample carriage which was sent to New York under option to capitalists there has been returned to the shops in Springfield. This gasolene carriage is of reasonable weight and speed, though the efficiency of the engine is not great.

The Winton gasolene carriage of Cleveland is now taking the lead, yet only fifteen of these have been sold to date. Mr. Winton, who is a bicycle manufacturer, has been working for about five years on his gasolene engine, and has produced a creditable carriage, two of which have found purchasers in Canada in the Messrs. Moody, of Hamilton. The carriages sell at $1,000, carry two persons, weigh about 2,300 lbs., and show go d speed and efficiency; but there is nothing radical in the construction of the engine.

The Electric Vehicle Company of New York is pushing the introduction of electric cabs with great energy and spirit. An interesting illustrated description of their battery system was published in the September number of the American Electrician. They certainly deserve success, yet their cabs while carrying only two passengers in addition to the motorman, are so heavy that they represent over 1,000 lbs. per passenger, and this enormous dead weight requires the construction of special wheels made of cast-iron mounted upon pneumatic tires. The cabs, however, are popular, and if once brought down to a commercial basis could be made a highly profitable business. A correspondent recently drew attention to the enormous field for motor carriages in California, where alfalfa hay is dear, and yet has to be transported with the caravans in order to feed the immense number of horses needed. It is usual to hitch up twelve horses to a single wagon, and yet with this enormous hauling power only twenty or thirty miles per day can be made. So far there has been no attempt made in the United States to develop the haulage of heavy traffic by autocars. There is to be an exhibition of motor carriages in Boston this month and next in connection with the 20th Triennial Exposition of the Mechanic Association, and prizes are to be offered in connection with motor carriage races, but nothing definite has yet been announced.

The steam carriage shown in the accompanying illustration was built in Birmingham, England, in 1870, by J. & W. R. Inshaw, now of New Bedford, Mass. The brothers were then in partnership with their father in the engineering trade. This carriage held ten passengers, not including the steersman and the boy who acted as stoker. The gross weight when loaded with water and coke was 3,000 pounds. There were two tanks for carrying water, which was introduced into the boiler with a force pump and injector; the tanks held sufficient for a two hours' run. The boiler, which was of the watertube type, steamed very rapidly, and steam could be raised to 100 pounds pressure in 1½ minutes from cold water. The engines consisted of a pair of long-stroke engines, with cylinders having a diameter of three inches and a stroke of 12 inches. These drove an intermediate shaft which had a clutch arrangement, and the power was carried by means of a chain, From Coventry to Birmingham (eighteen miles) in one hour is the best work this carriage has done when carrying its full complement of passengers.

We speak of Canada last. The Canadian Motor Syndicate has recently begun the manufacture of storage batteries on the Still Battery System, and have already equipped two types of vehicles (shown in the illustrations), one an advertising tricycle having a speed of ten miles per hour and a capacity of twenty miles without recharging, the battery weighing 150 lbs., and carrying in addition to the driver a load of 250 lbs.; and a Victoria seating four persons, having a speed of fourteen miles per hour, a capacity of thirty to thirty-five miles without recharging

and a battery weight of 350 lbs., the total weight of carriage being 800 lbs. As compared with the American and English, these Canadian electric carriages and their batteries weigh only about one-fourth, and yet are claimed to possess equal if not greater efficiency. The finishing touches are being put upon a new gasolene engine of Mr. Still's invention, to which reference was made in the illustrated article in THE CANADIAN ENGINEER of April last.

GARBAGE DISPOSAL IN MONTREAL.

BY W. M. WATSON.

Lately I visited and inspected the garbage incinerators in Montreal, which I was told cost $45,000. They have twelve furnace grates, six on each side of the main flue. The fire, places are about six feet wide each, and sixteen feet from front to rear, and have each two clinkering doors. The grate bars form a steep incline, and appear to be six feet higher at the rear than at the front doors, and terminate at the rear end—with a short shaft passing up to the floor line of the tipping floor—through which the refuse is passed down to the fire bars. Each furnace will hold about three tons, and they are apparently only charged two or three times each day. When first built they had a boiler which raised steam from the wasted heat (or should have done so), and steam blowers were supplied to increase the draught, and raise the temperature of the furnaces. But all such appliances have been taken off the apparatus; probably the men appointed to manage the works did not know the value of the appliances, and could not work them to advantage. There is also an extra furnace in the chimney flue that was placed there for the purpose of burning the fumes discharged from the furnaces prior to passing up the chimney and out into the atmosphere, but this is not used and no pretence is made of consuming the foul smelling gases passing up the chimney or to prevent the dust from escaping.

The fires are of course kept at a low temperature, and the ashes and clinker taken from the furnaces are of a soft nature and of little value for use on public works, though if a high temperature incinerator were near the clinker might be reburnt and made hard enough to use for roads, concrete, etc. The heat from the twelve fires is all wasted, showing how rich Montreal is. If the same amount of rubbish was burnt in England they would make profitable incomes from the heat coming from the fires from the many things of value that come mixed with the garbage, and also from the clinker that was drawn from the furnaces. But the British public authorities cannot afford to waste valuable products, they turn even their garbage into cash. There is a fine long chimney and large, straight flue running between the fires, having main and local dampers, so that the draughts can be wholly or locally cut off from each fire separately. There is also an incline road and tipping floor that covers all the fires and flues, well housed and roofed in. The garbage is chiefly vegetables, fish, meats, and light refuse, together with dead animals.

These incinerators are an improvement on the Toronto crematories, but even then they are a long way behind the garbage destroyers used in Europe, both from a sanitary and financial standpoint. As soon as some public authority has the pluck to have a first-class destructor erected and afterwards intelligently managed, the advantages over the present kind will be so apparent that Canada will see the last of the wasteful incinerators now in use.

—Toronto is about to make an experiment aiming at retaining trade in the eastern portion of the city by building a large hotel. The site chosen is one on King st. east, which has been left vacant by the failure of a large dry goods store. The promoters are not able, so far as we know, to point to a single instance in which it has been possible to alter the course of trade when once in motion toward the west. The new city hall and the large office buildings which have been built in the past couple of years to the north and west of the proposed site will have a much greater influence in drawing business towards them than will an hotel, even if the hotel succeeds, which upon the face of it is in the present case unlikely. To succeed it would require to attract tourists and to hold largely the local restaurant trade of the best class. The proposed site is away from the theatres, the fashionable promenades, the railway stations, the large departmental stores, from everthing that should be near at hand, and is in addition hot and unpleasant in summer, thus rendering a tourist trade impossible.

—There may be too much interference on the part of the Government with private interests, and we are accustomed on this continent to look with suspicion on Government regulations of any sort, but we are beginning to see more clearly the necessity of Government inspection of all works which are likely through defect to cause danger to public life or health. Liability of the owner to make good damages resulting from defective construction is not the safeguard in America that it has been found to be in England. Sometimes here the owner is a great corporation or controls a large local influence and investigation is burked. In the United States this is a usual, in Canada an exceptional circumstance. An example of what might have been a serious accident was recently brought to our notice. A high chimney for a large power-house had its foundation put in on a site where the nature of the soil and the work done made its collapse a certainty. Fortunately an engineer who happened to examine the work called the attention of the owners to the matter, the structure was taken down and a suitable foundation put in. In advance of an official report on the subject it is impossible to state the cause of the collapse of the O. & N. Y. railway bridge at Cornwall, Ont., described in another column. Had there been an efficient Government inspection of the work done on all railway bridges in and adjoining Canada we would have had on file the records of the borings made to locate the piers in the first place and a statement of the manner in which the concrete in the pier hardened as it was put in. With this and other data the public would be much more fully informed, and if these facts were published during the construction of the work many believe that the accident would never have taken place. Publicity in these matters is a good thing

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A SHORT HISTORY OF SEWAGE DISPOSAL AT THE ASYLUM FOR THE INSANE, LONDON, ONTARIO.*

BY R. M. BUCKE, M.D.

London asylum was ready for the reception of inmates in the autumn of 1870, and by the end of that official year 457 patients had been admitted chiefly from the Malden and Orillia branch asylums, which were thereupon closed. The sewage of the new asylum was thrown into a small creek three miles above the opening of the same into the south branch of the Thames, the said opening being three miles above the city of London. Every summer the creek became nearly or quite dry, and it was not very long before the farmers and others who lived along its course complained bitterly of the nuisance caused by the asylum sewage. Complaints and threatened prosecution were met by the establishment of a charcoal and gravel filter at the lowest point of the asylum land. The said filter was operated intermittently with more or less (chiefly less) success for some fifteen years. It would do its work fairly well when fresh charged: but it proved impossible, by any reasonable expenditure of labor and charcoal to keep it in a state of continuous efficiency. The protests of the property holders along the creek, which had been partially silenced by the establishment of the filter, broke out anew and were naturally intensified by certain cases

*A paper read before the Ontario Association of Executive Health Officers, at the Ottawa Convention.

of typhoid fever, which occurred among them. It became clear that some more radical remedy for the evil would have to be adopted, and it was finally decided to adopt that method of sewage disposal which goes by the name of Intermittent Downward Filtration.

A piece of sandy land, four acres in extent, was selected for the purpose. This, in the first place, was graded perfectly flat, and was then laid out in alternate beds and trenches; the beds being ten feet and the trenches eight feet wide. The difference in level between the surface of the beds and the bottom of the trenches is twenty inches. The length of the beds and trenches is 220 yards. The number of the trenches is eighteen. The whole plot was provided with an elaborate system of tile drainage, many thousand feet of two inch tile being used. These were supposed to carry the purified water of the sewage to a well situated at the southwest corner of the field, which well was expected to overflow into a surface drain, and its water to run to the head of an adjacent small creek. Experience showed, however, that this tile drainage was almost or quite unnecessary and useless. Of late years the tiles have been dug up here and there for the purpose of examination, and it has been found that no water ever passed into them—they were in precisely the same state as when they were put down—that is, they were apparently quite new and unused. In one part of the field, however, in which the soil is not so sandy, some water does pass into the tile in wet seasons. On the whole, however, water seldom runs into the well, and I have no doubt the field would do its work as well without the tile as with it.

The sewage field is on a slightly higher level than that on which the asylum itself stands; it is therefore necessary to use a pump. The sewage from all parts of the institution (including of course, all laundry and other impure water), is run into an underground tank 80 feet long, 40 feet wide and 15 feet deep. From this tank it is thrown once a day by a centrifugal pump through a six inch iron duct into a small well at the northeast angle of the sewage field. This well, after being filled, overflows into a long trough made of three two inch planks spiked together. Opposite each trench there is a short spout made with similar two inch plankings. Each spout is fitted with a sliding gate and just beyond each spout the trough is fitted with a similar gate. By means of these gates the sewage is turned into any trench desired. The whole arrangement is exceedingly simple, cheap and efficient. The centrifugal steam pump churns up the sewage so that when it comes to the field it resembles dishwater in appearance and is so dilute that it has very little odor.

The population of London asylum is in round numbers 1,000 patients and 200 sane people. The quantity of sewage made in a day averages about 75,000 gallons. It requires two and a half hours each day to throw this on to the field, and within from half an hour to six hours (according to the season of the year and the moisture or dryness of the earth), after it is thrown into the trenches, it has been absorbed by the soil. It is never seen again by us, doubtless it reappears at the surface somewhere as pure spring water. Only two to four trenches are used each day, so that the soil as used is always ready to absorb the sewage. There is no pollution of the soil; it is as sweet to-day as before it was used at all for the purpose in question. The disposal of the sewage then is absolute, as complete, indeed, as if it had passed out of existence. But it will be asked, how is it when the ground is soaked with long continued rain, or when it is frozen hard in very cold weather? Neither of these conditions trouble us. The sewage always disappears in the soil, the process only somewhat checked by previous soaking, and only slightly checked by frost; for the sewage, even in winter is always many degrees above the freezing point, and it thaws the soil sufficiently to make way for itself. Granted then a sufficiently porous soil, which can be found within moderate distance anywhere, this mode of sewage disposal is simple, certain and cheap. No expensive plant is needed, and there are no chemicals or other supplies to purchase to carry it out.

But this is not all, these are not its only recommendations. For the first few years, after adopting this method at London asylum we used the field for sewage disposal only; we simply kept it clean of weeds and grass, and maintained the level and form of the trenches. But seven or eight years ago the temptation to experiment with the field as a garden took possession of us. All that we did in this direction prospered. We watered the plants grown on the field with the sewage, being careful not to use it at such times as it could taint such a crop as (for instance) strawberries. We found from the first that in the beds between the trenches (although the soil in them was poor), we could grow by aid of the sewage immense crops. For six years now we have cultivated this field to its full capacity with the result that we grow upon it year by year crops of fruit and vegetables to the value of over $200 per acre. So that over and above the disposal of our sewage in a cheap and cleanly manner the sewage itself is so used as to bring us in several hundred dollars a year more than the field in its original condition could possibly (without the sewage), be made to produce. The crops we have grown upon the sewage field in the last six years have been as follows: Water and musk melons, squash, pumpkins, celery, peppers, cucumbers, tomatoes, peas, radishes, chilies, lettuce, beans, cabbage, beets, carrots, corn, onions, turnips, salsify, sea-kale, asparagus, parsnips, strawberries. Every one of the crops grown on the sewage field has done well. One of our most successful crops is melons, both musk and water, which we grow there every year. The yield is immense and we have grown better melons on this field than I have ever eaten grown elsewhere. We have had immense crops also of cabbage and celery, and the quality of the crops has been much above the average. I need hardly say that the fruits and vegetables grown on the field are as wholesome as those grown elsewhere. Neither is the health of those who work upon the field in the least affected, there are no healthier people about the institution than they. Why not? The field is simply a beautiful garden which is kept well manured and irrigated.

To sum up. The advantages of this mode of sewage disposal are many and great. It is cheap, simple, cleanly, not liable to get out of order, wholesome. It would seem to be nature's own plan of refuse riddance. It seems clear that solid excrement, including dead bodies, should be returned to the earth whose chemistry is competent to deal with it and utilize it without itself receiving taint or injury, and not to the waters which have no use for it, and which are tainted and grievously injured by it.

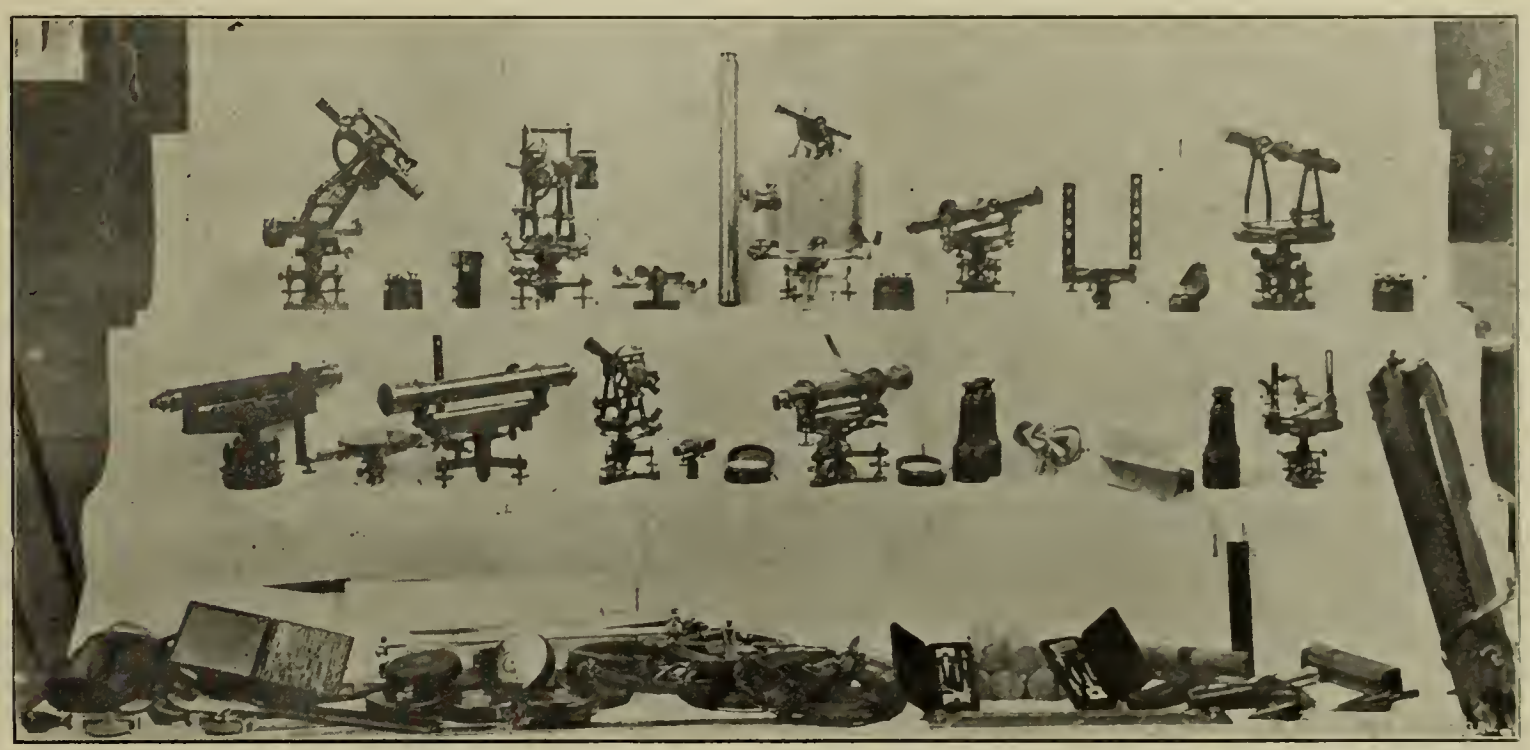
THE SURVEYING EQUIPMENT OF McGILL COLLEGE.

In consequence of the rapid growth of the Mining Department of McGill College consequent upon the completion of the McDonald mining laboratories, it became necessary to largely increase the equipment of the Surveying Department. This was made possible by the generosity of the same benefactor, W. C. McDonald, of Montreal. The accompanying engraving shows a number of the instruments added under this donation. It was made from a photograph taken in the east room of the Architectural Department.

The full list of instruments purchased is as follows: From Troughton & Simms, London, Eng., 14-inch Charlton Model. Dumpy Level; from L. Casella, London, Eng., 3-in. Transit Theodolite, Brydges-Lee, Photo Theodolite, Box Sextant with Supplementary Arc; from W. F. Stanley, London Eng., Box Sextant, Box of Drawing Instruments; from L. Lesdorpf, Stuttgart, Germany, Wagner Pocket Level, Precision Level, 4-in. Transit Theodolite, Goldschmid Aneroid Barometer, Prismatic Reflecting Circle, two sets Beam Compasses; from Martin Veig, Christiania, Norway, Wrede Pocket Level; from Chesterman & Co., Sheffield, 30-in. Straight Edge, 3 100-ft. and 1 66-ft. steel bands, half dozen linen tapes; from G. Cooper, London, Eng., Sidereal Watch; from Young & Sons, Philadelphia, U.S.A., 6¼-inch Railroad Transit, 6¼-in. Mining Transit with three tripods and interchangeable lamp targets; from Buff & Berger, Boston, U.S.A., 14-in. Dumpy Level; from Keieffel & Esser, New York, U.S.A., combined Architect's Level and Transit, 100 ft. steel band, 300-ft steel band for mining work, slide rules, scales, plum bobs and other minor equipment; from Lufkin Rule Co., Saginaw, U.S.A., 2 Steel Bands, ½ dozen Linen Tapes; from W. & L. E. Gurley, Troy, U.S.A., 4 Plane Tables, 2 Surveyor's Compasses, Solar Compass, Pantograph, Price Current Meter; from Hearn & Harrison, Montreal, Rochon Micrometer, 2 Aneroid Barometers, 3 Hand Levels, 2 Lemaire Field Glasses, Box Sextant, Parallel Ruler, Scales and minor drawing implements.

The effect of this donation has been to increase the number of instruments available for field work by fifty per cent. and to place ample opportunities for practical work at the disposal of

every student. In order to give the students full time to profit by this addition the session has been lengthened by one month in all the departments taking the surveying course, and the entire month of September has been set aside for field work. Some time in addition to this is given to underground surveying during the spring mining excursion. The course in full is designed to give the student all the technical knowledge necessary in order to qualify as a Dominion Topographical Surveyor in addition to the regular methods of practice in railroad hydrographic and topographical surveying. The instruction is given by field work, lectures and plotting, and office work; the work in these latter being based upon the notes taken by the students in the field work. The field work will be given this year in and around the village of St. Andrews, Que., and will commence with preliminary practice in the use and adjustment of the instruments to be followed by the carrying out of the following surveys by the several years:



INSTRUMENTS IN THE SURVEYING DEPARTMENT OF M'GILL UNIVERSITY.

Fourth Year Work.—Base line measurement, triangulation by geodetic methods, precise levelling, magnetic observations, and the determination of latitude, longitude, azimuth and time both in the day time and at night.

Third Year Work.—Topographical surveys of selected areas by plane table stadia and photo theodolite, a hydrographic survey of part of the Ottawa river, including the determination of its discharge, a location survey for a railroad between Carillon and St. Andrews.

Second Year Work.—Chain Survey of part of the village, compass and chain survey of farm lands, micrometer surveys.

In the making of these surveys the years are divided into small parties not larger in number than would be employed in practice, and each party carries out its complete set of surveys independently, each student being required to have a full set of notes of the work done by his party. The students are thus compelled to learn to carry out the duties which will be given them in practical work, and the necessity of full and accurate notes is impressed upon them in the plotting of their own surveys, which is done in the winter months after field work has become impossible. From the plans thus made quantities and estimates are calculated.

The field work and mapping has been organized in this manner so that the students may fully appreciate the practical importance of the facts concerning theoretical and practical surveying that they hear in the course of lectures upon this subject, and will learn to depend upon their own judgment and to understand that an acquaintance with the literature of a subject does not qualify a man completely for the practice of it. The organization and conduct of the surveying department is under the charge of Prof. C. H. McLeod and his assistant, J. G. G. Kerry.

W. W. Ogilvie is building what will be the largest grain elevator in Montreal. The plans are already completed for its construction, and it will have a capacity of 2,000,000 bushels. It will have a frontage of 240 feet and a depth of 290 feet.

RECENT METHODS OF SEWAGE DISPOSAL.

BY CHARLES G. HORETZKY, C. E., OF THE ONTARIO PUBLIC WORKS DEPARTMENT, TORONTO.

The following paper on the most recent methods of sewage disposal now in operation in the United States, being to some extent the outcome of experiments made by the Massachusetts State Board of Health, with remarks upon their adaptability (in whole or in part) to cities in Canada, was read before the Association of Executive Health Officers of Ontario during the meeting in Ottawa in September, and also at the meeting of th American Public Health Association.

At the tenth annual meeting of the Association of Executive Health Officers of Ontario held at Belleville, Ont., in 1896, I read a paper upon Methods of Sewage Disposal then used in some of the Provincial Institutions of Ontario. In December, 1895, I was one of the consulting engineers with reference to the disposal of the sewage of the city of London, Ont., and then recommended a system of land disposal or filtration; my recommendation being largely based upon the successful working of the Brockton, Mass., plant then in operation, and upon the very doubtful success of several chemical systems visited upon a tour of inspection through the United States in October of that year. Since 1893, further, and most important discoveries in this direction have been made by the Massachusetts State Board of Health at their Experimental Station at Lawrence, Mass., where the last few years have been devoted to researches upon the capabilities of gravel and coke filters aided by forced aeration. A description of these experiments would be interesting, but out of place here, and can be seen in the different annual reports. It will suffice to say that the conclusions arrived at offer a great incentive to the practical ingenuity of all those interested in the construction and maintenance of sewage disposal plants.

It has been demonstrated that filters of gravel of an effective size * of 5.40 MM. can produce a most satisfactory effluent, and remove from 60 to 85 per cent. of the organic matter of strong city sewage, at the rate of 400,000 gallons daily per acre. Coke breeze (screenings from commercial coke) has also been found of immense value as a filtering and straining medium, and possesses the advantage of being fully as valuable for purposes of combustion after its use as a sewage strainer and sludge retainer, as before. This will be discussed further on. As regards the forced aeration applied to these experimental filters, pipes were passed through, and within 6 inches of the bottom. A fan blower driven by electricity was attached, and, while the fan made 3,600 revolutions per minute, an air current capable of sustaining 3 inches of mercury was forced through the filters. By frictional loss the force of the current was reduced fully one-third.

In the experiments with the coke filters up to January 1st, 1895, the average rate of filtration was 260,000 gallons per acre

*(Note: In a sample of sand or gravel, the effective size is the maximum diameter in millimeters of the finer ten per cent of the sand grains, or gravel).

daily for six days in the week, while the average removal of organic matter (albuminoid ammonia), and bacteria was 95 and 98 per cent., respectively. In 1894 Col. Waring instituted experiments upon sewage purification aided by forced aeration, at Newport, R. I. These were continued during five months from May till October, and the results set forth in a pamphlet which also contains a synopsis of the chemical work and investigation carried out simultaneously by Geo. W. Ralfe, A. M. (Harvard). The Willow Grove Park (15 miles from Philadelphia) sewage disposal plant was constructed shortly after upon the principles evolved by the Newport experiments. It is simply composed of a set of strainer and aerator beds, one-eighth acre in extent in all. The sewage applied daily is assumed to be from 60,000 to 100,000 gallons. The resulting effluent at date of my visit on 6th Sept. was very good, clean and odorless, and the most of it was in daily use for sprinkling the lawns and roadways at Willow Grove. I found, however, that the receiving well was clogged with hard compact sewage to the depth of 4 feet. This will have to be removed eventually by hand, as it cannot be pumped up. The man in charge informed me that the plant had been one year in operation, and that the strainer beds have to be overhauled every season (six months), and the material washed and returned to its place. This, he says, occupies three men during a week.

As to the conclusions arrived at by the chemist in charge during Col. Waring's Newport experiments, they indicate that a strainer tank can remove 40 per cent. of the nitrogenous matter in ordinary sewage, if this sewage, roughly strained and free from mud, is applied continuously, at a minimum rate of 3,000,000 gallons daily per acre; and that an aerator bed one acre in extent, with nitrification properly established, and proper manipulation, will remove 95 per cent. of the organic nitrogen of a strainer effluent, applied at a rate of at least 800,000 gallons daily. It will do so for an indefinite period, under, of course, proper conditions of working. This means that ¼ acre of strainers, and 1 acre of aerators (1¼ acre in all), will suffice for the treatment of the sewage of 10,000 people at the rate of 80 gallons per capita. I have been unable to obtain the cost of the Willow Grove plant, now about one year in operation, which includes the pump house, pump, blower, masonry and concrete work, filtering material, and all accessories; hence, it is difficult, nay impossible, to compare it in the large and practical way with other methods which will be discussed further on; but, from my own actual observation, and the statements of the man in charge, I am of the opinion that the conclusions reached by the experimenters are quite in accordance with the actual working of this very valuable system of artificially aerated bacterial filters as claimed by the inventor, whose theory regarding "Bacterial oxidation" of sewage is pretty generally understood.

Reverting to the Massachusetts State Board of Health experiments with coke, I now quote an extract from page 480, report 1896, which sums up the immense value of this material as an aid to sewage purification, and especially as a sludge retainer: "When Coke Breeze can be obtained, and the sewage given a preliminary treatment before sand filtration, by being passed through this breeze at a high rate in gallons daily per acre, the organic matters can be removed from the entire body of the sewage as completely as chemical precipitation removes them from the main body of the sewage. There is no resulting sludge liquor from this coke straining process, and the clogged coke can be removed from time to time and burned, the sludge being of course held by, and burned with it.

"During some of the experiments 13.8 cubic yards of coke per million gallons of sewage filtered were removed, dried and could have been used as ordinary fuel. By straining through coke we have removed during 1895, 54 per cent of the sludge (albuminoid ammonia) of the sewage. The latter has been strained at an average rate of one million gallons per acre daily, and the coke strainer contained from 6 to 8 inches in depth of coke. The coke is known as breeze (screenings from ordinary coke). At the Lawrence Gas Works where it is obtained, it is used under the boilers, and estimated to be worth one-fourth as much as the steam coal, or, from $1 to $1.25 per ton; the amount used has been 10 cubic yards per million gallons of sewage strained, and, as a ton of coke occupies about 2.3 cubic yards, the sewage has been purified, to the extent given, at a cost for coke of $5.43 per million gallons of sewage strained, estimating the coke to be worth $1.25 per ton. By this method we remove the sludge from the entire body of liquid, and get rid of the concentrated sludge liquor which results from sedimentation, or any chemical precipitation process, and, it seems that the coke is as valuable for combustion after use in the strainer as before."

I may add that in the coke filter experiments of 1895, the removal of organic matter and bacteria, at a rate of 260,000 gallons per acre daily, for 6 days in the week, was 95 and 98 per cent., respectively. Now, sludge resulting from sedimentation or chemical precipitation contains 90 per cent. of water, the latter being separated from the solids by a most expensive and dirty method of pressing. Even then, the resulting cake contains 50 per cent of water, and, using the lime and alum precipitation process (probably the best), the pressed sludge will amount to eight tons per million gallons treated, equal to 40 tons as swept from the tanks. As one-half of the pressed cake consists of water, the dry solids are equal to 4 tons per million gallons of sewage. In the Lawrence experiments above quoted, the sludge was removed by burning at a cost of $5.43 for coke per million gallons treated, while, in any chemical process, 8 tons of semi-fluid, evil-smelling cake are produced at a heavy expense for filter presses, cloth and labor, and afterwards the problem of getting rid of this foul asset has to be faced, since it is utterly futile to think of selling this cake to farmers, and the further expense of carting it away must undoubtedly be taken into consideration. In England the cost of producing sludge cake may be taken, at the majority of works (according to Santo Crisp), at 2s. 6d. sterling per ton; and the same authority states that although it is sometimes sold for a trifle, or taken away by farmers, the latter are as often paid to remove it. In the vicinity of large cities it has been dug into the ground, or spread out to dry, but, however, handled or disposed of, it is an undoubted nuisance; hence any method of sewage disposal whereby the sludge difficulty can be eliminated entirely, must recommend itself to practical men. In estimating the cost of sludge removed (per million gallons of sewage treated), by coke strainers, as against sludge pressing into cake, we have roughly, taking the Lawrence prices of materials used:

BY COKE STRAINERS.

Say 4½ tons of coke at $1.25	$5.62

BY SLUDGE PRESSING.

Pressing 8 tons sludge cake at 60c	$4.80
Carting away 8 tons, ditto	....
1,000 lbs. crude alum at $25 per ton	12.50
1,000 lbs. slaked lime at $9 per ton	4.50
Required for precipitation of one million gallons of sewage	$21.80

Therefore, is there much to be said in favor of coke as a strainer, as compared with any precipitation process; while the cost of buildings, tanks, and the other accessories required in the last named process, will certainly counterbalance that of a furnace, drying ovens and chimney necessary for clogged coke combustion. The Pennsylvania Sanitation Company of Philadelphia have taken advantage of the foregoing facts as regards the valuable properties of coke breeze and aerated sand and gravel filters, in their sewage disposal plant erected at Reading, Penn., which has been in very successful operation for the last year and a half.

The population of Reading is about 80,000, as I am informed, but so far only about 25,000 people contribute to the sewerage system. The average daily flow of sewage treated by the Philadelphia Sanitation Co.'s works during August last was 1,586,463 gallons. These works comprise a very handsome pumping station situated at 6th and Canal streets. This station includes two large receiving reservoirs in which the coke strainers are placed, two large pumps of 5,000,000 gallons capacity each, three 65 h.p. boilers, drying ovens and tall chimney stack, which ventilates the receiving chambers. A force main 7,200 feet in length conducts the strained sewage along the banks of the Schuylkill River to the filter beds. These filter beds comprise an area of 25,000 square feet, or fifty-seven hundredths of an acre. One-half of this area is supported by an iron structure, and is at a level 8 feet 6 inches higher than the lower half. The upper beds are divided up into ten compartments, each 25 feet by 50 feet. Iron pipes resting upon beams and girders, supported by iron columns, carry the filtering materials which con-

sist of three different layers of broken stone and rather fine sand; the whole being two feet in depth. The surface of the filters is protected from wind and the erosive action of the falling sewage by a slatted floor removable for cleaning purposes.

There is usually one foot head of water on the upper filters while in operation. The open grid-iron like bottom affords access to the outside air, and is, in fact a modification of the forced aeration experiments of the Massachusetts State Board; further aeration is obtained by the 8 foot 6 inch rain-like drop of the effluent to the surface of the second filter, which is of coarser material, and about three feet in depth, and is aerated throughout by pipes and gutters. The effluent from the last filter emerges as a clean, bright fluid, quite sufficiently purified to enter any large stream or river, and certainly of a better quality than that of the Schuylkill into which it finally empties.* Bacterial and chemical analyses of the effluent from this plant have been made in Philadelphia, and these show high results, as the accompanying statement indicates. Usually about one-half only of the filtering area is in operation, the other half being rested, aerated and cleaned. The cleaning operation involves the daily removal of about two tons of the sand on the top of the filters which has become clogged by the organic matter still remaining in the coke strained effluent. This daily loss of sand costs about $2 for the material alone. Reverting to the preliminary operation undergone by the crude sewage in the receiving chambers at the terminus of the main sewer, there are two suspended layers of coke, 12 inches thick, through which the sewage must pass. The upper one holds back the coarse sludge, while the lower effects a partial filtration or straining of the sewage before it is taken hold of by the pumps. Every week the sewage is shunted from one receiving chamber to the other, and the clogged coke of the upper strainer is entirely removed, hoisted to the drying ovens, and finally consumed under the boilers as ordinary fuel. The weekly removal of clogged coke from the upper strainer is about 5 tons. In my opinion the clogged coke should be removed at more frequent intervals, and the coke should be, not commercial coke such as I saw, but breeze, or ordinary coke broken up into very small fragments. I believe the specifications of the Sanitation Company demanded "breeze," but, since the plant has been turned over to the corporation of Reading, several changes for the worse seem to have been made. During last August the cost for steam coal was $72 for 48 tons. In addition to this 16 tons of coke from the receiving chambers were burned. The total quantity of sewage pumped during that month was 49,180,368 gallons. The cost of this plant has been given to me as under:

Pumping station complete with 1 pump and 2 boilers	$59,000
The pipe line	31,000
Site for disposal works	7,000
Right of Way	1,700
Iron structure for filters complete, including viaduct over creek and all accessories	62,300
	$161,000

As one-half of the upper filtering area is said to be generally out of operation for cleaning purposes, it follows that the daily flow of sewage treated (1,586,463 gallons), passes through the upper filter at the rate of about 2,286 gallons per square yard, or 11 million gallons per acre. Although this seems an enormously rapid rate, it must be borne in mind that the second filter below will pass the effluent from the first filter at only half the above rate, and that, with the large amount of aeration obtained, not only by falling through the 8 foot 6 inch air space, but through the last filter, very good results can certainly be looked for. As a matter of fact a very fair sample of effluent was collected by me on the 4th instant. As regards cost of labor, it is safe to say that four men and a foreman could very well attend to the filters, although at present three foremen and eight men are employed by the corporation of Reading. Careful examination and enquiry as to the operation of the Reading sewage works have convinced me that this practical application of coke straining and aerated filtration is worthy of the very serious consideration of the London, Ontario, authorities, who still have the vexed (and to them doubtless most perplexing) question of their sewage disposal before them.

On account of several conditions essential to successful intermittent filtration through land, which are not always obtainable, this plan is certainly far in advance of land disposal pure and simple, over large areas, as it is generally understood in Ontario, and which I unequivocally recommended three years ago. But this is in reality a land disposal system in a much condensed form, with but a fractional portion of the duty imposed upon it as in ordinary cases, by reason of the prior removal of the bulk of the sludge by coke combustion as already described. Upon this account, and that of the reduced cost of construction and future maintenance, as compared with other proposed plans, I unhesitatingly recommend it now. The Pennsylvania Sanitation Co., of Philadelphia, have offered to construct a disposal plant at the outlet of the Cove Road Main Sewer, much upon the same lines as that of Reading (the London works of course to be a gravitation system), for the sum of $28,000. This is upon a basis of one million and a half gallons of sewage to be treated daily. I have carefully gone into the plan proposed by them for London, and feel confident that, with certain modifications, which include receiving chambers, coke ovens, furnace and chimney, besides provision for burning the rakings from the upper filter, an excellent system can be constructed for the sum of say $33,000. The company would, I have no doubt, be glad to operate the works for one year, and guarantee a given, satisfactory standard of purity in the effluent.

The whole work necessary in caring for the filter beds, handling, and finally burning the clogged coke, could be performed by four men and a foreman. The weekly cost for coke (the only material requiring renewal, besides less than a couple of tons of sand daily), would be about 5 or 8 tons, the total weekly expenditure for materials for one week being, 8 tons of coke, and say 12 tons of sand. The cost of chemicals alone, per week of 7 days, would be for the International System, using 7 grains of ferozone per gallon of sewage (7 grains ferozone per gallon of sewage are not sufficient, as I have found by actual experience, 10 grains are necessary), and estimating the cost of ferozone at ½ cent per pound (which is 50 per cent. less than I ever obtained it for): 10,500 lbs. at ½ cent=$52.50 per week, or $2,730 per annum. So much for maintenance; now for the cost of construction by either of the three plans proposed for the City of London:

LAND DISPOSAL.

40 acres of land at $175	$7,000
Preparing ditto	24,000
Syphon and other items	10,000
	$41,000

INTERNATIONAL PROCESS.

Cost of construction as given	$41,300
Plan now proposed	$33,000

The latter, besides being less costly, possesses the inestimable advantage of being entirely freed from the sludge nuisance. The interests of the city of London can be protected by the company's guarantee to keep up a certain standard of purity in the effluent during the period the works are operated by them. The location of these works at the end of the Cove street sewer would of course obviate the necessity for a syphon as now proposed.

The city of Worcester, Mass., may safely be taken as a typical illustration of chemical precipitation for large cities, and the report for 1896 may be referred to, in which it is shown that, for maintenance, and purification of one million gallons of sewage, the cost has been $10.52, 53.9 per cent. of the organic matter having been removed; and yet Worcester is now engaged upon the construction, at great expense, of a filtration plant as an auxiliary to their present method. The sludge from the Worcester works has always been found very difficult to get rid of, and when there in 1895 I saw very large areas covered with it to a depth of 12 or 18 inches, small quantities of which the neighboring farmers could scarcely be prevailed upon to take away as a gift. Enough has now been said on this head, and the method of precipitation as applied to large towns with

*These works have been extremely well designed, and appear to me to be an excellent practical illustration of the Massachusetts experiments with coke and "forced aeration." The filtration area is rather circumscribed—a defect easily remedied. Too much credit cannot be accorded the designer and engineer—John Jerome Derey, of Philadelphia.

its sludge concomitant, may be dismissed with a quotation from Col Waring: "The precipitation treatment buys and manipulates chemicals, coagulates the sludge, drains it, pumps it, handles it, and still has it."

It must not, however, be gathered from the foregoing remarks, that the writer has receded from his many previously stated convictions regarding precipitation methods. There are and always will be cases arising, where, in the absence of coke or suitable land, chemical precipitation will be found a powerful aid to the final filtration of sewage, either through natural or artificial media; and this applies particularly to the sewage disposal of small communities, e.g., as in some of our provincial institutions, or other small centres of population.

Since reading the above paper in Ottawa I have suggested a still further modification in the method proposed for London, which is to use 20 acres of land for the final filtration of the sewage, after straining through, and retention of the sludge by coke. This is a combination of the Reading plan with simple land filtration, and would effect a saving to London in cost of construction of nearly $20,000, as compared with the original "all land disposal" plan and the chemical "International system."

DR. KINGSFORD.

Dr. William Kingsford, C. E., the Canadian historian, died at Ottawa, Sept. 29th, in his 79th year.

He was born in the parish of St. Lawrence, London, England, in December, 1819, was educated there and spent some years in the army, coming to Canada with the 1st Dragoon Guards. On leaving that regiment, in 1841, he obtained professional employment in the city surveyor's office, Montreal, and was subsequently for three years deputy city surveyor. He resigned his position to join the late Murdo McIver, on the Montreal Times, being with that gentleman part proprietor and joint editor of the paper. After two years the paper was discontinued and Mr. Kingsford returned to his profession. He was appointed to the engineering staff of the Public Works Department, remaining there for two years, during which time he completed an important survey in connection with the Lachine canal, determining the boundaries of the Crown property. Proceeding to the United States, in 1849, he was engaged there on the construction of the Hudson River Railway. Later he went to Panama, where he became assistant to John C. Campbell in laying down the line of the Panama Railway from San Pablo, on the Chagres, to within a mile of Panama.

On his return to Canada he was appointed by the Commissioner of Public Works on the location surveys of the Grand Trunk Railway. He surveyed the line from Montreal to Cornwall, and also examined a back line from Brockville to Rideau. Subsequently, he surveyed and located for construction a line on the south shore of the Ottawa from Vaudreuil to Montreal, now the C. P. R. short line. Resigning his position on the Grand Trunk, he accepted the city engineership of Toronto, which, however, he held only for a few months, going back to serve under the late A. M. Ross, engineer-in-chief of the Grand Trunk Railway. In 1860 he returned to England. Subsequently he was employed in Italy in the examination of several works. He also reported to Mr. Brassey, on the condition of the Sardinian railways. Six years later he returned to Canada and again entered the public service. For several years he was engineer in charge of harbors in the provinces of Ontario and Quebec. Afterwards he was employed on the Canadian Pacific Railway. When his engagement on this road terminated, Mr. Kingsford, whose tastes had always been literary, and who had contributed much to periodical literature, resolved to undertake the preparation of a history of Canada from its settlement to the union of Upper and Lower Canada. The first volume of this work appeared in 1887, since when a new volume has appeared every year. His other contributions to literature in book form include: "History, structure and statistics of plank roads in the United States and Canada," 1852; "Impressions of the West and South," 1858; "The Canadian canals, their history and cost, etc.," 1865; "A Canadian political coin; a monograph," 1874; "Canadian Archaeology; an essay," 1886; "The early biography of Ontario," 1892; "Some considerations on the advantages we may hope to derive from education," 1898. The degree of LL.D., was conferred upon him by Queen's and Dalhousie Universities in honor of his history of Canada. He was a Fellow of the Royal Society of Canada.

PURIFICATION OF SEWAGE BY MIXING WITH PURE WATER.

BY W. M. WATSON.

I have been asked the question, "Is it injurious to discharge sewage into large sheets of fresh water similar to the Georgian Bay, or rivers similar to the St. Lawrence at Montreal?" My answer is, "Yes." And those like myself who have seen the effects of discharging raw sewage into the rivers and lakes, and even into tidal waters of the ocean, surrounding Great Britain, will have no difficulty in bearing similar testimony. It is possible to purify sewage through the agency of pure water, but to do this the sewage must be mixed with at least three times its own volume of fresh water, and both be well shaken together so that every molecule of the sewage liquid comes into close contact with at least three of the pure water. When this is done the cleansing microbes contained in the pure water are able to destroy the dangerous microbes that the foul sewage contains, and herein lies the difficulty, because the mechanical appliances needed to supply the quantity of pure water, and properly mix it with the sewage, will usually cost more than cleaning the sewage by artificial filtration. When sewage is discharged in bulk into rivers and sheets of clean water it moves through and passes along with the currents in a compact body, and being slightly heavier, on account of the solids it contains, it settles to the bottom as soon as the temperature has been reduced to the temperature of the water surrounding it. It then sets up a rapid putrefaction, breeding and multiplying dangerous germs, which in course of time become so numerous that however large the sheet of water may be, they become masters of the situation, and either foul the whole body of water and cause it to discharge a foul odor as do Toronto and Hamilton bays, or the poisonous gases generated belche up in volumes through the clean water, and cause a nuisance similar to the gases discharged from the saw mill refuses lying at the bottom of the river at Ottawa. In many cases large patches of the microbe-bearing filth will float to the surface, and be cast on to the banks, jeopardizing the health of the inhabitants. This can be seen in many places where raw sewage is discharged into tidal rivers, bays and large lakes of fresh water.

It may be possible that a rapid running river will purify its contents, but it is very improbable that it will purify raw sewage. I have often read of attempts to prove that the sewage of a town got purified after running for about six or seven miles down stream, and the analysis of water taken from the surface has appeared to prove this to be the case. But experience, and the hundreds of fouled rivers in Europe prove decidedly that the scientists are wrong. As I have stated, the sewage falls to the bottom and so leaves the surface of the river clean and pure, and it is on this account that taking samples of water and analysing them is misleading, for the evil is still in the river, but resting on the bed at the bottom. It is from the sludge at the bottom, in quiet places, and under rocks where the currents are not felt that the sample for analysis should be taken.

The argument that a town or private residence can run its sewage into clean water without injuring their neighbors and future generations is stale and untrue, and it should not be entertained for one moment, for there are thousands of examples in the older countries that will refute it. Only this morning I read a letter published in The London Times, written by the Archdeacon of Gloucester, England, complaining bitterly of the fouling of the fresh water streams of England, and killing the fish they formerly contained. He showed the folly of pretending to purify sewage by irrigative land. Here is an extract from the reverend Archdeacon's letter; let him speak himself:

* * * * * *

"Let me ask your help in promoting such welfare in one momentous direction—the disposal of sewage. There are few evils, in my opinion, more pressing or even scandalous than the pollution of rivers. Water is one of God's most precious gifts (poor East London will testify to this). To turn a fair river into a foul drain, seems to me, not only a hideous blunder, but a hideous crime. Will you let me open a correspondence on the cremation of sewage, for our pest may thus be turned even to our advantage? I plead for the erection of huge furnaces at the outfalls of our drains. No doubt they would require lofty chimneys, and chemical ingredients to neutralize the noisome gases; but this, surely, cannot be beyond the reach of

science. In these furnaces the solid matter would be burnt, and form artificial manure; the liquids, being properly filtered and deodorized, might then be allowed to flow away. Let us sum up our present position. Our beautiful West Riding rivers are only awaiting their time for being turned into foul channels of manufacturing centres. 'Sabrina fair,' is rapidly becoming 'Sabrina foul' to the great discomfiture of the salmon. Limpid Thames is condemned to bear the ignoble burden of London sewage. Have we not heard of a huge sewage island being piled up on the borders of Essex? Have not the oyster sellers been half ruined by sewers disgorging themselves near the oyster-beds of Kent? Have we not heard of the 'Ealing Styx'—the Brent? Fifty-seven years ago my father had his kitchen garden surrounded by that pretty river at Hanwell. I am now staying on the coast of South Hampshire. A nice little trout stream empties itself past the village into the sea. Up the stream trout are caught abundantly, below the houses large fish are caught, but ought not to be eaten, for a disgusting freight of sewage is carried to the sea, and Oceanus has to dispose of the accumulated poisons as best he may. Shame to say, it is the same story for all our watering-places.

"Now, what are the palliations on which we place our reliance? Miserable subterfuges indeed—sewage farms. At first we heard much of the enrichment, now we hear of the poisoning, of the soil. At best it is the spread of noisome exhalations over fair fields instead of fair rivers. I do not envy the olfactory senses of the man who walks anywhere near the sewage farm. The huge sewage marsh at Saltley, near Birmingham, had to be thickly covered by masses of sand and gravel, I suppose to be in their turn as much poisoned as the stratum which lies below them. No doubt we must come to cremation sooner or later; but why not sooner than later? I throw out this suggestion, to be taken up, I trust, by practical and scientific men. I am sure he will be a public benefactor who can turn a curse into a blessing."

This is the view of a gentleman ripe in years, who has watched the irrigation of land, and the mixing of sewage with large quantities of clear water for half a century, and he tells us that they are useless and a mistake, and breeders of filth and foul odors. The slow going government of Great Britain has at last come to see that the two systems are of no value, and have lately begun an exhaustive enquiry into every known system of sewage disposal, and intend examining all expert engineers and managers of sewage purification works on oath, and if possible find out the proper system of cleaning and extracting all poisons from sewage fluids. They commenced in August, but adjourned to October, when the holiday season would have expired. They will then continue with closed doors, as the commission is determined not to allow the papers to report the proceedings until it publishes its own report and opinions, which cannot be until probably next spring, as the enquiry will be lengthy. It is hoped that the enquiry will bring to light a system that will be both efficient and permanent, at a reasonable cost, and so supersede the many worthless processes now in use.

ROPES AND ROPE DRIVING.*

BY L. H. KENYON, DUKINFIELD.

To trace the history of rope driving, we should have to go far back beyond the days when Hero of Alexandria applied his discovery of steam power to rotary motion, which but for fanaticism, that great impeder of all progress, would centuries ago have deprived Watts of the glory of first invention. We must search amongst the mounds of Nipur (which have recently proved that civilization is older by 7,000 years than the world was supposed to be), and among the ruins of ancient Egypt to find the clumsy first forms of the potters' art. Comparing these with later but still early productions, when grace, beauty and utility first joined hands, we come to the time of the potters' wheel. Still later the Hindoo wood turner begins to ply his trade, and may even to-day be seen sitting, as his ancestors have done for unknown ages, with tool in hand ready to catch the backward turn of his lathe, as his half naked attendant "see saws" at the ends of a rope whipped several times round the hub. Or again come down to still later times in our own country, when we have the spinning wheels. Arkwright after repeated experiment found it advisable to still adhere to this principle for driving the spindles of his spinning machine, a method which modern development has only sought to improve. Strange to say, some thirty years ago when the machinery of the mill occupied by this genius was undergoing re-construction, a system of rope transmission was found to be in full operation. How long this had existed we can only conjecture, but doubtless some obscure mechanic had conceived the idea of applying band driving to higher powers from the models around him, or it might have been the offspring of the master mind. At any rate the fact remains, notwithstanding the many who claim to be the foster parents of the system.

For all practical purposes rope transmission may be regarded as positive, all things being equal, and in making calculations for speeds the supposition that slipping and consequent diminution of speed must of necessity enter into the equation, may be dismissed as scarcely worth consideration. Cases have come under the writer's observation where ropes have supplanted spur gearing, and the machinery indicated loss of speed, but after the most careful investigation the main driving proved dead true to the decimal, and, in one instance, the pulleys were altered throughout the room affected, to meet the difficulty arising out of a misunderstanding of the initial speed. Beyond this, and of supreme importance to power transmission, is the elasticity of rope driving, for the ropes themselves are very sensitive to any irregularity and act as a buffer between the initial and ultimate power, making back-lashing, the bane of gear driving, an unknown quantity. This quality is displayed to a remarkable extent in driving from gas engines, where the ropes may be seen readily yielding to every impulse, and just as readily recovering their normal tension without transmitting the shock to the machinery. If even a slight loss of power be admitted, the general effectiveness of ropes more than compensates for this, which is too often magnified beyond its merits, and can be reduced to such dimensions as will enable the engineer to ignore it entirely in actual practice. It often happens that reports are received of ropes slipping, which on investigation prove to be quite groundless. Should there be any slip it can easily be detected by the heating of the pulley. Unless, then, pulley rims are unbearable to the touch from frictional heat, it may be taken for granted that there is no perceptible slipping. Stress should be laid upon this, because frictional heat appears to be rarely associated with slipping, and the evil is often declared to exist without its natural result.

In our works we have tried a 5/8-in. diameter rope running over a loose pulley 18-in. diameter, with grooves of an angle of 90 degrees, making 160 revolutions per minute, or a rope speed of about 720 feet per minute. This 18-in. pulley was brought to a dead stand, and as the driver was only 12-in. diameter, caused the rope to run only about one-fourth its proper speed (say 180 feet), and in rather less than two minutes the paint on the inside of the rim blistered and smoked with the heat. In the above-mentioned experiment, the heat was generated upon a portion only of the surface on account of the pulley being stationary, but when in motion the heat is more evenly distributed, so that it would not require a great amount of slip on a large driving pulley to set up heat sufficient to scorch the ropes. What would be the result with a pulley 3 feet diameter, an acute groove, and a number of ropes of larger size, side by side, slipping at the rate of 60 feet per minute? And yet we have a case in hand at the present time, where an engineer has proved over and over again to his own satisfaction, that of four engines running side by side, the ropes are slipping on two of them at the rate of 60 feet per minute. This was said to be going on continuously, without producing the slightest heating of the pulleys or injuring the rope in the least degree. If then, there is loss of speed on the machinery and no heat on the rim, the cause must be looked for elsewhere than in the rope chamber.

To those who lay so much stress on wedging action, back tension, etc., the following problems might prove interesting:

Say, the wedging of a rope into its groove is stated as 50 lbs. (an excessive estimate) and the centrifugal force for 1¾-in. diameter travelling 4,700 feet, is 192 lbs. What amount of power can be absorbed on extracting the rope after accomplishing its purpose? Or how can these opposing forces co-exist?

The resilience of a well made cotton rope is such that perfect impact into the groove is impossible, even when the rope is forced into it under far greater pressure than is ever exerted

*A paper read before the Manchester Association of Engineers.

in actual practice. This causes it to spring away immediately the tension is withdrawn, even from a groove with sides at an angle of 25 degrees, and with the pulley stationary. How much less then would this presumed wedging action apply to grooves of 40 degrees with the pulleys running at a high rate of speed ?

As in every other method, there are many points to be observed and enforced before the high tide mark of efficiency may be reached. First and foremost, the construction of the groove; and let it be said that simple as it may appear, the contest between one style and another has been keen in the extreme. The most effective style of groove is that with straight sides resting at an angle of about 40° and of sufficient depth to prevent the rope reaching the bottom, or the curve with which the groove terminates. On no account should grooves with curved sides be used, as it is impossible for ropes to bed themselves, and they roll round, do not last near as long, and are not as effective. It need scarcely be said that the grooves of both driver and driven pulleys should be turned to the same template. Although there are numerous instances where ropes have been expected to do well when they were running in grooves of totally different make and size.

It is generally acknowledged that ropes should not be run upon pulleys of less than 30 times their own diameter. Although good cotton ropes will coil in considerably less compass, yet it is always wise not to go below this limit, and err, if at all, in the direction of large size pulleys, as the repeated effort of compression and extension produces what is well expressed as "fatigue of material," when the elasticity is worked out. Ropes suffer more from this cause than any other. The writer has come across numbers of cases where the relative diameters have not been more than half this, and ropes have been expected to do just as well as under more favorable circumstances.

The best results may be anticipated when the smallest pulley is 50 times the diameter of the rope.

Whilst it may be safe to advocate forward driving generally, i. e. with slack over the pulleys, the writer fears he will be compelled to renounce his faith in its supremacy for all conditions, and advocate another method for horizontal and down driving particularly, since recently comparing notes upon the many methods under consideration. He can bring to mind quite a number of cases where back driving has been adopted perforce with the best results. So smoothly do these ropes run that the idle side maintains the same equal curve without any perceptible deviation, whilst under similar conditions forward down driving has been anything but steady, and there has even been a difficulty in keeping the ropes in the grooves. Therefore, to secure effective down driving, back motion becomes almost a necessity. The great reason for this is that the centrifugal impetus given off by the driving pulley would, but for the check from its own endlessness, throw the rope far above the horizontal plane. These two opposing forces combine to create a wave-like motion which is intensified in proportion to its slackness or the erratic power applied, until, as before mentioned, there is danger of the ropes leaping the grooves and so threatening the safety of both machinery and attendant. In forward driving, a rope curves in two opposite directions in descending from and ascending to the pulleys, whereas, in back driven ropes, the curve is in the same direction, and therefore renders no assistance whatever to undulatory motion. It is of course necessary to make the usual allowance for loss of frictional power upon the pulley between over and under driven ropes. In upward driving, such as largely prevails in our cotton mills, this tendency is effectually bridled by forcing the rope to run against, instead of over the pulley

(To be continued).

THE CORNWALL BRIDGE DISASTER.

The fall of two spans of the New York & Ottawa Railway bridge over the United States channel of the St. Lawrence river, near Cornwall, Ont., has roused a great deal of interest both from the magnitude of the disaster and its unusual nature. The number of men killed in the accident is 15, while 16 were seriously injured. At the time of the accident the erection of both the fallen spans had been practically completed, and under one the falsework had been removed. On the other span the workmen had begun to take down the traveler, but most of them were working on the floor of the bridge when the accident occurred.

Principal interest, of course, centres in the construction of the pier which went down with the two spans. As the accident occurred on the United States side of the river, the Engineering News, New York, has made a thorough investigation of the subject, and we reproduce the data it gives: The river at the site of the pier is about 35 feet deep, and has a swift current, said to be about 5 to 8 miles per hour. The river bottom is a clay hard-pan in which are imbedded boulders, many of them of large size. The pier was founded by sinking a timber crib 18 feet wide, 62 feet long and 38 feet in height, and filling it with concrete deposited under water by buckets arranged to empty automatically on striking the bottom. The anchoring and sinking of this large crib in the deep water and swift current was a task of great difficulty. To accomplish it a small crib filled with stone was sunk up-stream to serve as an anchorage and a 3-inch steel cable was led from this to the pier crib, which was also supported by a barge on each side. Cables led to the river bank were used to swing the crib in the stream till it was in the correct position.

The swift current made it impossible to examine the bottom by divers before sinking the crib. Soundings were taken over the site of the crib, however, and the crib bottom was scored to correspond to the depth thus obtained. After the crib was down divers went down inside and obtained samples of the bottom, which was deemed satisfactory by the engineer, and the work of concreting began. The first concrete laid, to the amount of about 50 cubic yards, was deposited in bags, all of which were placed by divers around the sides of the crib. The remainder of the concrete was then deposited from a bucket holding about 1 cubic yard, arranged to dump automatically on contact with the bottom. The concrete was deposited in successive layers of about 18 inches over the whole area of the crib, and divers reported it as setting satisfactorily. The concrete was mixed by hand in the proportions of 1, 2 and 5, using Glen's Falls Portland cement. It may be said here that the crib itself was built of 12-inch timbers, drift-bolted together, crossties of the same size were inserted at 10 feet intervals, the vertical spacing being about 4 feet.

The concrete was carried up to a point 4 feet below water level, and was then pumped dry, the top of the crib projecting above the water forming a coffer-dam. The top of the concrete appeared in good condition, and upon it the masonry was started. Two courses were laid and then work was shut down for the winter, all the above-described work having been carried out last fall. During the winter the pier was subjected to heavy ice pressure, which, as most engineers know, is a severe test of any pier built in the swift current of the St. Lawrence; but it was not moved. Early in the spring, we are informed, it was struck by a heavy timber raft, which was broken up by the collision, and the pier showed no injury.

Work on the piers was resumed in the spring and they were built up to their full height of about 35 feet above the water, making the total height about 70 feet from the river bed to the

pier coping. The masonry of the piers was rock-faced ashlar, with a backing of Portland cement concrete.

The specifications and working drawings for the bridge were made under direction of F. D. Anthony, chief engineer of the New York & Ottawa Railway Co., and were approved by A. A. Stuart, M. Am. Soc. C. E., now engineer of the Degnon-McLean Construction Co., of New York, who was consulting engineer to the railway company. They were also approved by the Canadian Government engineers.

The accompanying illustration reproduced from The Engineering News will be examined with interest. The north end of each span is in each case the fixed end. Thus on Pier 2, which fell, the channel span rested on expansion rollers, while the shore span, which still had the falsework under it, was anchored to the coping. The channel span turned partly on its side in falling, and its end-shoe is now about 25 feet south of Pier 3, on which it formerly rested. The shore span carried the falsework down with it, and, falling into shallow water, made a tangled mass of wreckage, as shown in the illustration.

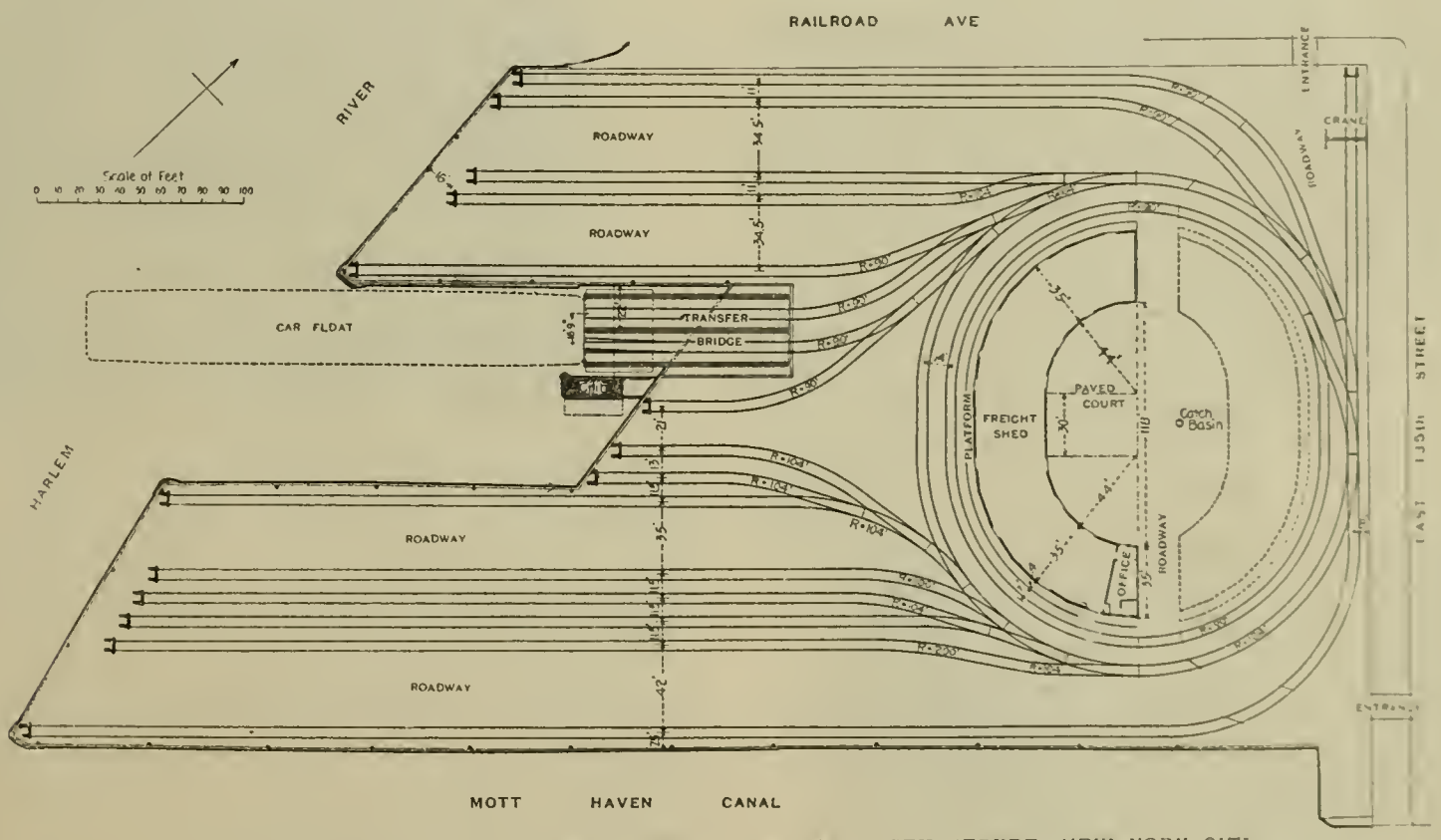
A NOVEL CITY FREIGHT YARD.*

The illustration of the terminal freight yard of the Harlem Transfer Co., at Harlem River, New York City, shows a novel and efficient solution of the difficult problem of developing a railroad freight yard with suitable switching facilities within the narrow confines and comparatively small space of a city block. This unique and original plan was designed by Walter G. Berg, M. Am. Soc. C. E. Construction began last April, and the terminal was formally opened July 5, and is in successful operation.

The problem offered was to develop the property for receiving and delivering carload or package freight, the cars to be transferred on the usual railroad car transfer boat, operating in connection with transfer bridges, to or from any of the railroad trunk line terminals on New York harbor. The standard three-track transfer car float, built for the Harlem Transfer Co., is 35 feet 6 inches by 240 feet in size, and has a track standing capacity for seventeen cars. In order to keep the outer end of the boat, when tied up to the bridge, within the proper limits beyond the bulkhead line, the shore end of the bridge had to be placed within 280 feet of the line of 135th street. Thus the development of the track system was confined to a space 280 feet ahead of the bridge and about 330 feet in width.

The leading feature of the design is the loop track, or full-circle switching track, from which all side tracks and connections start. All switching operations are absolutely positive, as there is no possibility of the engine getting pocketed. In some operations the engine takes hold of the cars only once; in other cases the engine cuts loose from the head of the string of cars and runs around and takes hold of the tail of the train.

A short tangent inserted in the loop track allows a switch to be taken out on the inside of the curve leading to an interior circular track as a standing track for a circular or annular freight house with an interior courtyard for teams. By this method the space inside of the circle is not only fully utilized, but ground space is actually saved. In the usual freight house layout there is considerable lost space between the wagon doors on the wagon delivery side of the house, as the spacing is generally made to correspond to the spacing of the car delivery doors on the opposite side of the house. In the plan presented,



FREIGHT YARD OF THE HARLEM TRANSFER COMPANY, 135TH STREET, NEW YORK CITY

The Harlem Transfer Co. is a corporation formed by several New York capitalists to establish a railroad freight receiving and delivery station for the Harlem River district of the city, following the general tendency to bring the cars nearer to the shipper and receiver of freight. While the company has made close traffic arrangements with the Erie Railroad, it is a strictly independent company and freight is to be handled from and to other railroads. Lighterage and wharfage business will also be handled to a limited extent. The scheme for the establishment of this yard was originated by and the work carried out under the supervision of J. C. Watson, the present general manager of the company. The yard is situated on the northeast side of the Harlem River, about half way between the Third Avenue and the Madison Avenue bridges, and covers the block bounded by East 135th street, the Mott Haven Canal, the Harlem River, and Railroad Avenue east of the New York Central. The block has a general width of about 330 feet and an average depth of 540 feet from 135th street to the river. The property was bulkheaded and filled in at different times in the past prior to its purchase and had a slip 100 feet wide and feet long, as shown on the plan.

*Printed from Railroad Gazette, New York, July 29, 1898.

the car delivery doors correspond to a spacing of 40 feet between car doors, whereas the corresponding spacing of the wagon delivery doors is only about 20 feet. There is also an increase in track frontage of the building for a given floor surface. Thus, the half-circle freight house in the plan, as now built, has a car frontage of eight cars, whereas the actual average length of the house is only 240 feet, corresponding to only six cars.

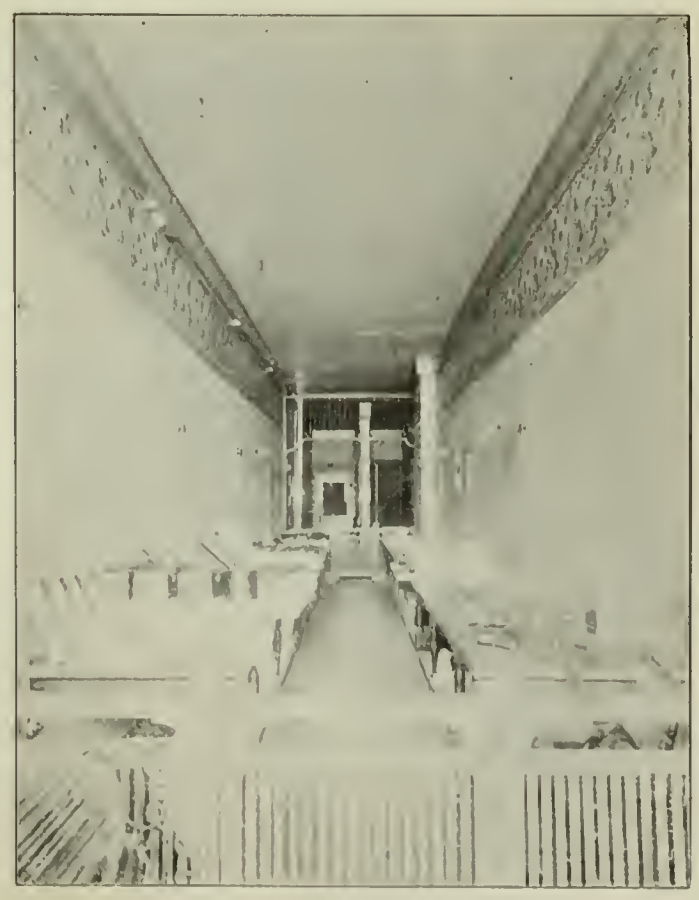
The circular switching track and the interior radial freight house, with the inside courtyard for teams, in connection with the apparent simplicity of the track system, are the prominent features of the design. Otherwise the details are the usual ones for similar first-class work. The freight shed is an iron frame single story building, 35 feet wide, on brick piers, sheathed with corrugated iron and roofed with tar felt and gravel. The transfer bridge is a regular three-truss wooden railroad transfer bridge, 100 feet long, the shore seat resting on a pile foundation and the sea end on a wooden pontoon, 40 feet by 32 feet by 8 feet. All the wagon roads are paved with block pavements and the trackwork is of the usual grade. The rails are 70 lbs., switches of the Wharton split spring pattern, 10 feet long, ground-throw switchsands, frogs of the bolted and filled pattern, oak ties at switches and on curves, yellow pine ties on

tangents. The ballast for the track and the bed under the paving is hard coal cinder. Finally, attention should be called to the important feature of the sharp curves utilized. The sharpest curves have a radius of 90 feet, while the "light" curves have 104 feet radius. These radii correspond, approximately, to No. 3 and No. 3 1-3 frogs. The gauge of track on curves is spread to 4 feet 9 inches, and the outside rail elevated 2 inches. The switching engine is a Baldwin 4-wheel enclosed tank dummy locomotive, 6 feet 6 inches wheel base, 44 inch wheels, 17 inch by 24 inch cylinders, and weighing, fully loaded, about 90,000 lbs. It is 27 feet long over all.

The use of these heavy curves at this terminal and the fact that heavier curves (even as small as 76 feet radius) are in use at the Brooklyn terminals of the Brooklyn Wharf & Warehouse Co. and at the Greenpoint terminal of L. M. Palmer, may perhaps serve as an object lesson to railroad companies, as to what can be done, if necessary, when confronted by confined and cramped conditions. Cars, especially with different kinds of couplers, will not couple readily on the heaviest curves mentioned, but special long links are provided for this purpose. As far as cars are concerned, however, there is no difficulty in passing them around these curves, naturally at slow speed, the elevating of the outside rail being an important track detail. Of course, a special switching engine with short wheel-base is necessary. The contractors for the work at the Harlem yard were George W. Rogers & Co., of New York City, for the transfer bridge and dock work; and Sandford & Stillman Co., of Jersey City, for the freight house, grading, paving and track work. Mr. George F. Morse prepared the detailed plans under Mr. Berg's supervision.

FIRE-PROOF CONSTRUCTION WITH LUXFER PRISMS.

One of the most valuable features developed in the manufacture and use of Luxfer Prisms is the discovery, which the owners have just announced, that a window of Luxfer Prisms glazed in copper by the electrolytic process, is absolutely fireproof. By an experiment carried on in the presence of a number of Fire Underwriters and city officials in Chicago recently, panels of Luxfer Prisms were heated in an open fire until they were red hot throughout; then the hose was turned on, and the fire extinguished, and the red-hot prisms drenched with water, the result was that the glass prisms were crackled into millions of pieces, but were securely held in place by the copper ribbons throughout the panels. It might be



explained that the Luxfer Prisms are made of sections of glass, 4x4 inches, glazed together with copper ribbons between the sections, and the whole panel cemented together and strengthened by an electro-deposition of copper. In this way it was shown that a panel of Luxfer Prisms may be exposed to intense heat; in that condition further exposed to drenching with water, and still retain their strength and operate as a complete barrier to flames passing through a window.

Another feature of the use of Luxfer Prisms is the fact that light can be carried into large interiors from windows, instead of through skylights and light wells. Light wells are a great hazard in any building, and any device that will enable a builder to do away with them is of immense value. As a practical exemplification of this, we can instance the case of the building occupied by Michie & Co., grocers, Toronto. In their store—the central portion was lighted by a large light well and skylight—a fire broke out on an upper flat and the flames were carried downwards, strange to say, through the light well, and destroyed valuable goods on the lower floors. Naturally they were anxious to remedy such a hazard, and on looking into the merits of Luxfer Prisms decided to have them placed in the front and rear windows, and see if they could get enough light without the light well. The installation was made and the

light well closed up completely by a steel clad ceiling. The store is better lighted in every respect, and the risk of the light well is entirely removed. A feature of this character is of great practical value and well worth consideration on the part of engineers and architects in designing buildings, to have a minimum of risk from fire. Apart from their value as above described Luxfer Prisms are stated to be very useful in carrying light into dark places—as may be seen in the accompanying cuts. These are made from two photographs of the interior of a large sample room, 100 feet long, lighted only by a large plate glass window at the front. The dark cut shows the appearance of the room without the prisms, and the light cut shows the effect of the prisms in lighting the back part of the room A demonstration like this tells its own story.

TARRED MACADAM FOR ROADS.

A. H. Campbell, city engineer of Canterbury, England, is an advocate of tarred macadam roads, and has recently been giving his experiences to the British Association of Municipal and County Engineers. Broken lime-stone is warmed either by building it up in alternate layers with coke or by building it in a cone closed at the top and fired in the middle. About 54 bushels of coke are consumed in a stack of 60 cubic yards. Both these methods cause loss as some stone is too violently heated and so disintegrates. An oven or kiln is to be preferred as the heating is more equable.

The temperature of the stone when the tar is applied should be such that the palm of the hand can bear it with comfort. If it is too hot the tar will be destroyed as a binder, and if too cold it will be used so thick as to soften in very warm weather. The [illegible] when ready for mixing, is screened into material of three [illegible] to 2 inches for the body, ½ to 1 inch for the intermediate coat, and ¼ to ½ inch for the top dressing. The coarsest material is used in a layer 3 to 4 inches thick, the in-

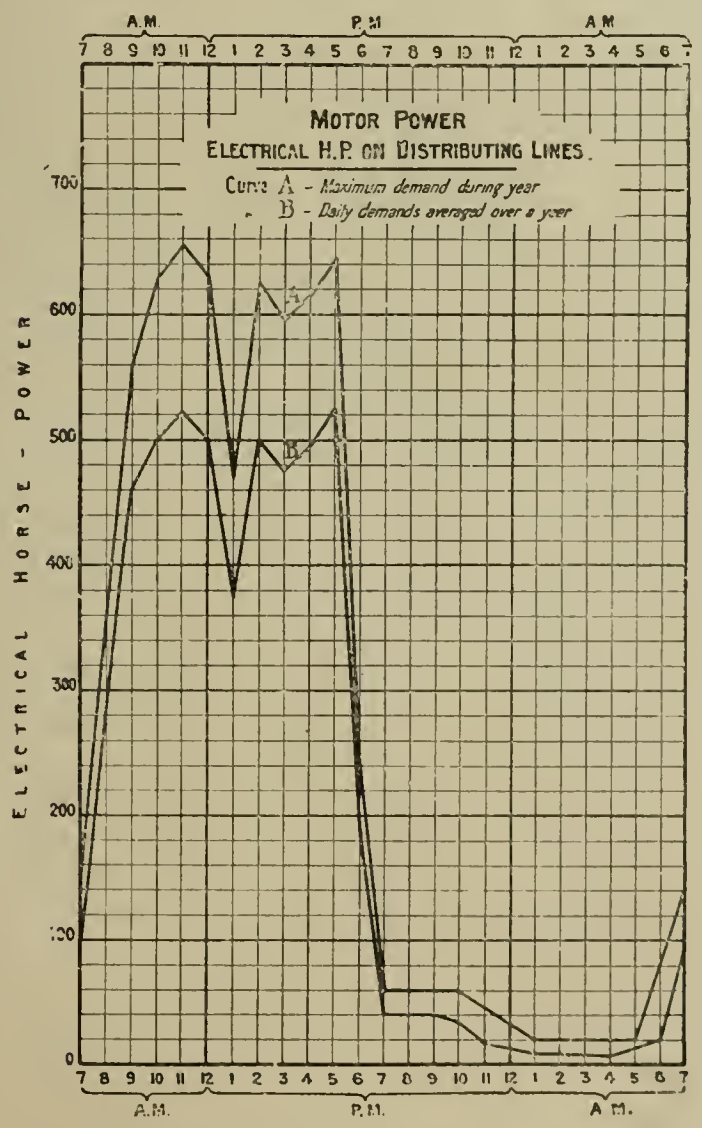
termediate size forms a coat of about three-fourths of an inch, and the top dressing is used in the thinnest layer possible, with a view to filling all interstices. Afterward a dressing of ¼-inch and smaller granite screenings is scattered broadcast, and the traffic at once allowed on the road to work this top dressing into the tarred material. Each of the layers is rolled separately with a 10-ton roller. It should not be laid in cold weather. The tar used should be of good quality, and heat should be applied long enough to secure great tenacity, but ought not to be carried so far as to make the pitch brittle. Mr. Campbell's practice is to boil the tar in kettles holding 50 imperial gallons for three or four hours, and then add half a bucketful of pitch and boil a short time longer. The cost of such a roadway varies with the price of material and the cost of labor. Mr. Campbell says his experience has been that a four to four and a half inch layer costs, for material alone, 36 cents per square yard, to which he adds 18 cents for excavating for the pavement, 20 cents for broken brick ballast, 18 cents for labor, 6 cents for rolling and 10 cents for contingencies, making the total cost $1.08 per square yard. This road is capable of bearing the heaviest country traffic, with an outlay of probably 4 cents a square yard for repairs, and is regarded as good for seven years.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A ROSS, E.E . M. CAN. SOC. C.E.

(Concluded from June Issue).

The load for all classes of demands is given to the last curve, which is formed from the others, and shows the period of the greatest station activity to be about six p. m. It is evident that apparatus must be installed to meet this maximum



demand, while the average output could be met by a much smaller plant. The interest and depreciation charges on plant, which forms such a considerable percentage of the cost of the output, is a constant, no matter what that output may be, so that, when it is possible to fill up the hollows in the curve by the sale of additional power during periods of light load, which shall not be operative during the period of heavy demand, the cost of this addition is only that of additional coal in steam stations, and in water powers is nothing, and for this reason may be disposed of at low rates. The table below illustrates the ratio of plant installed to the output column, one giving the average output per hour figured from the curves for a year, and column two the plant installed to meet maximum demands, while the third shows the ratio between them.

*From a paper read before the Canadian Society of Civil Engineers.

	Incandescent	Arc.	Motor Power.	Street Ry.	Total.
Average E. H. P., per hour	604	650	218	2,430	3,902
Max. E. H. P. required . .	2,925	1,300	656	6,450	11,331
Ratio output to capacity. .	20.6%	50%	33.3%	37.7%	34.4%

It will be seen that the output is only about one-third of that possible with the plant that must be installed. To dispose of the remaining two-thirds is the ambition of every station manager. It is just here that the storage battery finds its best field in steam station, but in waterpower plants it has no place unless the plant be loaded to its full capacity, and an increase is desired which the water available will not admit of. As an illustration of what is to be expected, the above case is useful, but so simple a case seldom occurs in practice, as instead of having the curves of actual demand, the engineer usually has to draw upon his educated imagination for these, guided by his experience with similar plants. Having determined the amount required for the various demands, and fixed upon the best method of distribution to meet those demands, the problem of the transmission may be taken up intelligently point by point.

Considering the direct current as out of the question for large transmission purposes, three different alternating systems present themselves, namely, single, two and three phase. The first we are thoroughly familiar with, owing to its use in the purely lighting stations where it is entirely satisfactory, but when it is necessary to distribute power for motor purposes it fails owing to the fact chiefly that single phase motors while practicable are not found suitable in operation as they are not readily started from rest. The question therefore hinges upon the point of relative superiority of the two and three phase systems. So far as apparatus is concerned, these two systems are about on a par for all practical purposes when designed for the same conditions of operation, but for the line the three phase has the best of the argument, the transmission copper being reduced 25% This point of superiority, however, loses much of its effect, for it is possible to use two phase apparatus at both ends of the line, and by means of suitable transformers change from two to three phase for the transmission, in which case the capacity of the transformers used must be slightly increased, as some of the copper is partially inactive when coupled up for change of phase. For this reason the three phase will be adopted in the case under consideration as being probably the cheaper in first cost and equal in efficiency.

As the copper in the circuit varies inversely as the square of the voltage for the same loss and distance the advantage of high voltage becomes apparent. Conversely with the same distance and copper, the loss in line may be reduced in proportion to the square of the proportionate increase, or the distance may be increased directly as the increase, and any combination of these may be attained by simply raising the voltage. On the other hand, the apparatus installed must be designed to resist the effects of the increase on the insulation, and greater precautions are necessary to maintain it in operative condition. The cost will also be somewhat greater where especially high voltages are used. The highest voltage in practical operation at the present time, so far as I am aware, is at Ogden, Utah, where 16,000 is used with raising transformers. The highest generated directly on the machine without the aid of transformers is 12,000 at the Chambly plant. There are several now building, however, which contemplate a line voltage of 20,000, and we may expect to see this figure increased from time to time as methods of insulation improve. It is well to remember that the apparatus will be called upon to resist much more than the normal pressure, owing to conditions of load, to opening of circuits under load, and to lightning, so that a large factor of safety is essential where high voltage is desired.

In former years a high periodicity of 120 to 133 per second was general, being suitable for lighting purposes, and by reason of the high period, transformer costs were low. With the advent of the alternating motor and of long transmission lines the periodicity dropped to 60, which is now the standard in America. In Europe, however, the tendency is to go even lower, and each maker of apparatus appears to have his own standard. The lowest possible, where incandescent lighting is to be done, is 25, for at this alternation the fluctuations are just visible in the light. The effects of lowering the periodicity are to decrease induction effects, which are always objectionable, simplify and cheapen the motor equipment and to increase somewhat the

cost of transformers. It would appear that for general transmission work, which involves the use of much power for motors, that a lower alternation would have met the case speeds better, but as 60 periods has been universally adopted on this continent it will probably be maintained for some time.

(To be continued.)

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

(Continued from last issue).

All ironwork, columns and pillars, beams and girders, should be "fire-proofed," i.e., covered with at least 4 inches of incombustible material, terra-cotta or brick. At the floor, and for a height of 4 feet in mercantile buildings, a metal guard should be employed to prevent the column from being stripped by collisions with rolling trucks for moving merchandise. It ought to be unnecessary to suggest that wooden lagging should, under no circumstances, be used to cover iron, were it not for the fact that in one of the largest and most costly dry-goods stores in New York, the "fire-proof" covering of the iron columns, which had been seriously damaged by trucks, was being systematically removed in order to substitute wooden lagging, when the fault was, fortunately, detected by an inspector of the underwriters. Four inches of good brick work is a good covering, but porous terra-cotta, or even wire lath and plaster, may prove effective. Where wire lath and plaster is used, the column should first be wrapped with quarter-inch asbestos, bound with wire. This would prove reliable and inexpensive.

A notable instance, showing the necessity of protecting ironwork with incombustible material, and the danger of expansion in long lines of iron girders or beams, was that of the destruction of a "fire-proof" spinning mill at Burnley, England, recently. This mill was 210 feet long by 120 feet wide, six cast-iron girders of the Hodgkinson type, each 20 feet long, spanned the 120 feet width, being bolted to cast-iron columns, and carrying, in turn, cross girders of wrought iron. The expansion of these 120 feet girders (they were unprotected) resulted in the disruption of the floor and the destruction of the mill. The cast-iron columns, being unprotected, collapsed under fire and water. The floors were 10 feet, 6 inches bays. As already stated, beams should not be spaced over 5 feet on centres. Wider spacing results in weak arches, liable to be buckled out by heat or punched through by the falling of safes or of other heavy articles from upper floors. The probability is, that if the 20 foot girders in this building had been arranged with provision for expansion, and all the ironwork had been thoroughly protected with "fire-proof" material, little damage would have been done. The effect, if the floors had been loaded with combustible merchandise, would have been more rapid. There was little wood to burn in the contents of the spinning mill, and yet the destruction was thorough. Such buildings with uncovered ironwork are more dangerous than those of heavy wood construction, in which the timbers are 12 inches or more in diameter, and not more than five stories in height. A properly constructed building with protected iron, however, is of course superior to any other form of building. Experienced firemen are afraid to enter buildings supported by iron columns unless they are thoroughly "fire-proofed," as they are liable to snap without warning under the influence of fire and water, whereas wooden posts burn slowly and give notice of collapse. They will stand a severe fire without being charred for more than two inches of their surface. In mercantile buildings and factories, beams, as already stated, ought not to be spaced more than 5 feet apart, no matter what kind of arch is employed; and while many experts claim that a heavy iron I-beam, thoroughly encased in "fire-proof" material on three sides, and having only its soffit or under side exposed, would not be expanded enough by the heat of a fire to cause its collapse, it is best to take no chances, but to protect the under side with "fire-proof" material, which can be cheaply applied with wire lath and plaster, or by having the skew-backs of the terra-cotta floor fillings extended below the soffit or bottom flange of the beam, and made with lips for protecting the iron.

It is a mistake, in my judgment, to dispense with tie rods even with the kinds of arches which employ wire cables or other metal ties. The claim is made that these act as tie-rods, but it should be remembered that they cannot be relied on during construction, when derricks for hoisting iron beams and other materials are resting on the girders. Dangerous lateral movements and twistings of the structure may be the result of want of rigidity, which can only be obtained by using tie-rods.

It is my opinion—but there are many who entertain a different one—that the old-fashioned brick arch is the most reliable for resisting fire; that next to this in safety stands the porous terra-cotta segmental arch, with end construction, i. e., the blocks or separate pieces placed end to end between the beams, instead of side by side, in what is known as "side construction." This is said to be stronger than side construction. It is claimed by many experts that porous terra-cotta is a better non-conductor than brick on account of its interior air spaces. The arch should not be less than 4 inches thick, having a rise of at least 1¼ inches to each foot of span between the beams, and there should be a covering of good Portland cement and gravel concrete over this to ensure a waterproof floor. Cinder filling will burn—crushed slag from blast furnaces is better, but the Portland cement concrete should not be omitted for waterproofing purposes. There are many patent floor arches for filling between I-beams which have great merit when properly put in, but I doubt if any of them are equal to the two I have named, and it should always be borne in mind that when employed they should be inserted with the same care with which they are prepared for tests. This is almost equally true, however, as regards brick and burnt-clay arches, also. There is less likelihood of poor installation work, however, with brick arches or segmental arches of porous terra-cotta or burnt clay. Arches should be laid in Portland cement, not lime mortar. Under no circumstances should they be laid in freezing weather, and where concrete is used the broken stone or gravel should be carefully washed, and the cement should be of the best quality.

It is of great importance that the floors of all buildings should be waterproof, in order that the volume of water thrown by the fire department to extinguish a fire may be carried off without injury to merchandise on the floors below. Neglect of these precautions is criminal in view of their simplicity and inexpensiveness. After the arches have been set between the I-beams they should be covered, for at least a thickness of 1 inch, with the best Portland cement concrete, carefully laid, so that all water will run to the sides of the building and be carried off by water vents or scuppers, which may be arranged with pipes through the walls, having a check-valve which would prevent the influx of cold air and yet admit of the out-flow of water. All ducts for carrying steam, gas, and other pipes and electric conduits should be protected with a metal sleeve going above the surface of the floor, and the space between and around the pipes should be filled in closely with mineral wool, asbestos, or some other expansive and "fire-proof" material to cut off draughts and flame. Floor boards should be dispensed with, if possible, and asphalt or concrete employed instead. It is hardly practicable in office buildings, however, to dispense with wooden floors. Wherever used they should be so laid, especially in mercantile or manufacturing buildings, that there is no air space to supply a passage for flame and to form a harborage for rats and mice, to which these vermin can carry matches, oily waste, or other combustible material, liable to be ignited by steam pipes or by spontaneous combustion. Various processes, "electric," so-called and otherwise, have been patented for "fire-proofing" wood. They undoubtedly increase the fire-resisting properties of wood for interim trim, window casings, etc. Whether or not they impair the durability of wood is a matter as to which I am not yet informed, and I doubt if sufficient time has elapsed for a proper test. The United States navy has made trials of "fire-proof" woodwork—with what success I am not informed.

The enclosures of all ventilating shafts, for water-closets, etc., light shafts, and dumb-waiter shafts should be constructed in the same substantial manner as freight elevator shafts. It is a mistake to use thin plaster board or plaster with dovetailed, or other metal, lath, etc. No enclosure should be relied upon less than 4 inches in thickness, well braced with an angle iron, but brick walls are best, especially in buildings over 60 feet high. The lights should be of wire glass, set in metal framework, and ventilators should have metal louvers arranged to secure ventilation, but not to increase a draught. Slats should be

riveted, not soldered, to metal framework, and the metal framework should flange well over the "fire-proof" material of shaft on both sides. It is possible to finish tin-covered "fire-proof" doors with wooden trim so as to be ornamental, with bead panel-work, etc.

(To be continued.)

CORUNDUM.*

The band of rocks of Laurentian age in the northern part of the county of Hastings and the southern part of the county of Renfrew, in which corundum has been found, may be said to be made up of three important kinds, gneiss, syenite and quartz pegmatite. What appears to be the oldest rock in the belt is dark colored and more or less gneissoid in structure. It is in all probability a metamorphosed igneous rock and might now be called gabbro-gneiss. In megascopic character it is pretty uniform throughout the belt. The dark colored minerals which predominate in it are horn-blende and biotite, of which the former is in greater quantity. The other generally most abundant constituent is plagioclase felspar, but in some cases the felspar, or the more basic varieties of it, is decomposed. The percentage of silica in the rock agrees with the view that it is an altered gabbro or gabbro-diorite. Several examinations were made of specimens from different parts of the belt and these range in percentage of silica from about 47 to 53. This gneiss, the oldest rock in the belt, is cut through by a series of dikes or masses, which consist largely of felspar or felspathoid minerals in which occurs the corundum. In some cases these dikes are light pink in color, while in other cases they are gray or white, depending on the color of the felspar, but the pink colored rock is less abundant than the other. These dikes are interesting in several respects.

Along the greater part of the strike of the dikes the rock has sometimes the character of coarse syenite, but in some cases it passes into nepheline syenite. In both varieties of rock corundum is found at times. Nepheline, a mineral which plays the part of a felspar in rocks, is a comparatively rare substance in many parts of the world. Some nepheline holding rocks when weathered have much the appearance of crystalline limestone, and are apt to be mistaken for this rock.

The most abundant constitutent in the group of igneous rocks in which corundum occurs is felspar, but this is replaced to a greater or less extent in some cases by the felspathoid mineral, nepheline. The other important constituents of this group of rocks, outside of corundum, are black mica, hornblende, which is sometimes represented by its very basic variety, hastingsite, and white mica. Quartz has never been observed by the writer in any hand specimen of rock taken from these dikes or masses. These dike rocks, if we leave out of consideration the occurrence of corundum in them, which of course lowers their acidity, may be described as syenites. Three or four varieties may be made of these. In some cases the rock is composed largely of felspar; at other times it contains mica or hornblende, and could then be called a mica or hornblende syenite; while, where the nepheline comes in, we have nepheline syenite. Magnetite is quite abundant at times. Pyrite is present in rare cases, and there is considerable variety of secondary minerals more or less mocaceous in character, which have not as yet been worked out. Where the syenite occurs in association with garnetiferous rocks, as in the northeastern part of Raglan, it carries garnet. Crystals of zircon, some of which had a diameter of one-eighth of an inch, were found in the syenite at one locality in Dungannon. Sodalite is sometimes present in the nepheline syenite. As the syenite on analysis appears to contain only a trace of magnesia, the poorness of the rock in spinel, which so frequently accompanies corundum in other districts, is accounted for. In general it may be said that the corundum occurs more abundantly in the ordinary syenite than in the nepheline syenite, but the crystals of corundum are usually much better formed in the latter than in the former. The corundum-bearing dikes vary much in width, which is usually some feet. In one case the writer observed a clear and well defined dike on the side of a hill in the thirteenth concession of the township of Carlow, whose width was only 1¼ inches and which had corundum studded pretty thickly through it. Other well defined dikes had a width of five or six inches. There are many dikes similar in character to those in which corundum occurs which do not contain this mineral. It may be present in one part of a dike and absent in another. It is frequently seen to have segregated in lines or patches through the rock, causing the rock to be richer in some parts than in others. Both the nepheline syenite and what has here been called the ordinary syenite often occur in broad dikes or masses, and it would be possible for one not making a careful study of the district to conclude that these two rocks belonged to different periods of eruption, or possibly came from different magmas. Sometimes the one rock passes somewhat sharply into the other in the same dike or mass. In this case if the line of passage is obscured one would be apt to conclude that the rocks belonged to different periods of eruption. But we have an "ear-mark" as it were in the occurrence of corundum in both kinds of rocks which at once attracts attention and causes one to look further into the relations existing between them. Having found that the nepheline syenite passed into ordinary syenite, and vice versa, in some cases following along the strike, the writer made use of this knowledge in prospecting for corundum. If a mass of nepheline syenite containing no corundum were found, the dike or mass in which it occurred would be followed up with successful results in some cases, the corundum coming in when the nepheline became less abundant or absent. In the case of one broad dike or mass in the township of Lyndoch, coarse nepheline syenite was found outcropping at the road side. After following the dike for about a mile, until nepheline was no longer observed on the weathered surface of the rock, corundum was found. In the case of other dikes search was rewarded with success in the same way. In somewhat close association with the syenite dikes of the corundum belt in parts of the district is a light colored granite in which corundum was not found.

In addition to the syenite dikes and masses, which cut the dark colored gneiss, there is another set of dikes whose relation to both of these rocks is easily made out. These dikes are quartz pegmatites, or coarse granites, and are younger than the corundum-bearing dikes, which is shown by the fact that these latter dikes are often cut by them. The quartz pegmatites are usually light pink in color and resemble in general appearance some of the coarser pink varieties of the corundum-bearing dikes. These coarser varieties of the latter dikes may also be spoken of as pegmatites. The quartz-bearing dikes contain as essential constituents in addition to quartz, felspar, which is usually the most abundant mineral present, and hornblende, which is usually pretty badly decomposed. Magnetite is a frequent accessory mineral in these pegmatites. Two or three trap dikes were observed which appear to be of later origin than the corundum-bearing dikes, and probably also than the quartziferous dikes. Crystalline limestone, generally in small areas, was found in different parts of the district, but in no case was this rock seen to be cut by the corundum-bearing rocks. These areas of crystalline limestone may be considered as outliers over the fundamental gneiss, and were no doubt at one time connected and formed areas of considerable extent, but have been disconnected by denudation.

Corundum has been found occurring under different conditions in crystalline rocks. In some cases it is an original constituent of the rocks, i.e., it was formed at approximately the same time as the mass of the rocks in which it occurs. In other cases the mineral is of secondary origin, having crystallized out in the rocks at a later date than most of the material with which it is associated. Corundum occurs as an original constituent in different igneous rocks. In eastern Ontario it occurs, as has been stated, in syenite. In other countries it occurs in granite, basalt, andesite, trachyte and other igneous rocks. Corundum is found as a secondary constituent in various metamorphic rocks, having been produced in them through the agencies of alteration to which they have been subjected. In Eastern Ontario and other parts of the world, e.g., Burma, etc., it is found in crystalline limestone. Some of the best gem varieties of the mineral have been found in this rock. Rocks of all kinds carrying corundum are broken down through the action of the atmosphere and other agencies into gravel and sand, and hence the mineral is often found in loose deposits in the beds of streams and elsewhere. In these water deposits it is found associated with other mineral of high specific gravity, such as native gold and magnetite. Some of the foreign localities where the mineral occurs in economic quantities are

*Extracted from the report of the Ontario Bureau of Mines 1898, Vol. VII., Part III.

those of North Carolina and Georgia, (corundum), Chester, Mass, (emery), and Montana, (gem varieties). A great part of the emery of commerce comes from Turkey and the Grecian Archipelago. Gem varieties are obtained from Burma and other parts of the world.

The mineral corundum is one of the hardest natural substances known, being excelled in hardness only by the diamond. Its position in the scale of hardness arranged by Mohs, is between that of the topaz and diamond. As corundum is often more or less altered or changed into secondary minerals, mica, etc., care should be taken in selecting a specimen of this mineral for a test of its hardness to make use only of a specimen which shows no sign of alteration, and which appears to be free from impurities. As corundum is also somewhat brittle, care should be taken not to be deceived by the breaking of the mineral. A crystal of quartz with smooth surfaces is useful in distinguishing other hard minerals. As most minerals which have a hardness greater than that of quartz are comparatively rare, one has generally little difficulty by its use in determining whether a given specimen is corundum or not. A crystal of topaz is still more useful, and small crystals of this mineral can be obtained from mineral dealers at small cost. The prospector for corundum should also possess some typical specimens of the mineral for the purpose of comparing hardness and other characteristics.

Corundum is composed of the oxide of aluminium (Al_2O_3) but traces of the oxides of other metals are generally present as coloring materials. As in the cases of other minerals of non-metallic lustre, the color of corundum varies considerably. Sometimes the mineral is colorless or white, and at other times it is found possessing a blue, pink or red, brown, gray or other color. The relative weight of corundum compared with equal volumes of many other minerals is high. It has a specific gravity of about 4, i.e., it is four times as heavy as an equal volume of water, while felspar has a specific gravity of from 2.4 to 2.7 and quartz of 2.5 to 2.8. Its weight in hand specimens thus aids in its determination. Corundum crystallizes in what is known to mineralogists as the rhombohedral division of the hexagonal system. Well developed crystals are often somewhat long and narrow, tapering towards a point at either end. A cross section of a crystal is six sided. When the crystals are well developed they possess a number of planes at either end. Crystals of the mineral, however, from different localities differ considerably in form. The crystals of this mineral generally possess a well defined parting, or show a tendency to split readily in certain directions. On some of these parting surfaces two sets of very fine lines are generally distinguishable, dividing the surface into small four sided areas. Corundum is infusible before the blowpipe, but is slowly dissolved in borax and phosphor salt. It is not acted upon by acids. If finely pulverized the mineral takes on a blue color after heating with cobalt solution. There are three subdivisions of the species, to which the name corundum is given, recognized in the arts. These are: (1) Sapphire, which embraces the purer kinds of fine colors, transparent or translucent, which are useful as gems. These gem stones are given different names according to the colors as sapphire (blue), and ruby (red). (2) Corundum, which includes the non-transparent kinds of dark or dull colors. (3) Emery, which is a granular corundum, black or grayish black in color, and more or less intimately mixed with magnetite or haematite. Some varieties of corundum are among the most costly and highly prized gem stones. Corundum has been produced artificially in various ways, different compounds of aluminium being used for the purpose. In most cases these compounds are subjected to the action of other substances at a high temperature. It has been formed by the decomposition of aluminium chloride through the action of magnesium and water vapor in a closed tube; by the decomposition of potash alum by means of charcoal, and in other ways. Many other minerals and even rocks have been produced artifically in the laboratory, but in most cases the results obtained have been of little economic importance. An interesting artificial production of corundum, considered in connection with the occurrence of the mineral in eastern Ontario, in nepheline syenite, is that in which the mineral has been produced by dissolving allumina in melted nepheline, and allowing the molten mass to crystallize.

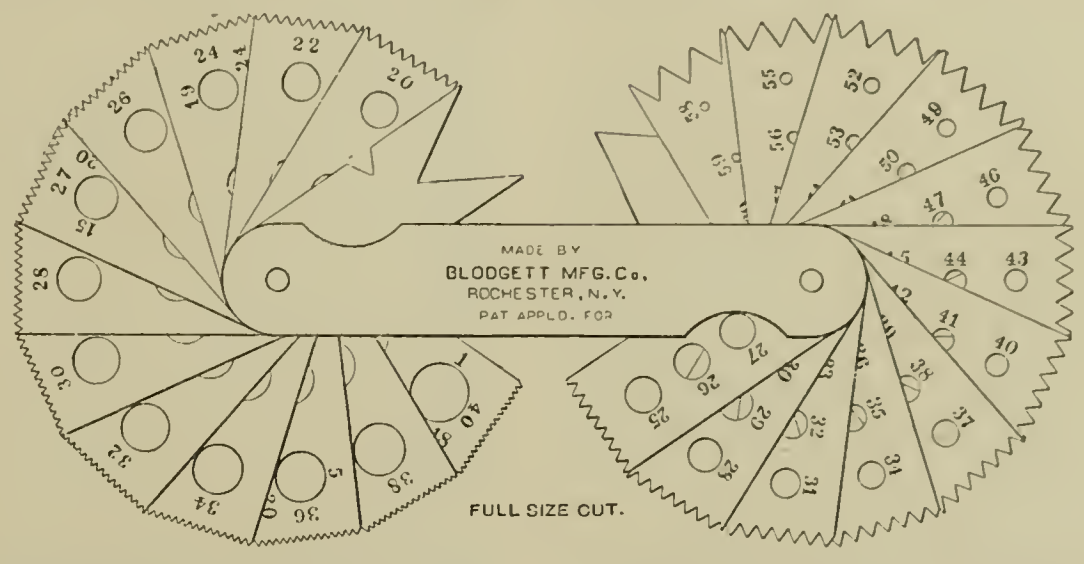
In commerce corundum and its varieties are divided into two classes, viz.: Gem stones and abrasive materials. The gem stone varieties have already been referred to. They are of comparatively rare occurrence, and when of high quality they are of great value. By the term "abrasive material" is understood a substance which is used for grinding or polishing purposes. Corundum proper and emery are used for this purpose. The powdered substance is made into "emery" wheels, the grains being cemented together by some suitable substance. The use of emery wheels in grinding down steel or other instruments is well known. Some of these wheels are moistened with water when being used, but others have to be used in the dry state, their cement not holding together after being wet. Emery is also used in the form of grains and powder. Corundum has been used in the production of aluminium, but as it is in such demand as an abrasive material it is too costly to be used as an ore of this metal. If its price were lower there would no doubt be a demand for it as an ore, on account of its generally being pretty pure and possessing such a high percentage of the metal. The uses of aluminum are being constantly extended. Many interesting results have been obtained with it in connection with alloys, one of which is of particular interest in Ontario. It is stated that of the alloys so far examined the one which seems to give the best present results and the greatest promise, is that with nickel. The addition of a few per cent. only of nickel to aluminium greatly enhances the strength and toughness of the metal, and adds to its brilliancy without adding materially to its weight. The metallurgy of aluminium offers a very inviting field for research. Alumina in a suitable form for the extraction of the metal is said to sell at about 4½ cents per pound, or two tons of alumina, which represent about one ton of the metal, are worth about $180. As aluminum sells at $700 per ton there would seem to be a considerable chance for the discovery of methods of extraction whereby the metal could be produced more cheaply. Moreover it does not seem altogether unlikely that methods of extraction will be discovered whereby a less pure alumina than that demanded by manufacturers at present can be used for the production of the metal.

Different varieties of corundum were known to the ancients, who made use of it as a gem and as an abrasive material. The emery of the Grecian islands has long been known. It is thought by some that the native races of America, judging from certain carvings on rocks, have made use of the mineral. In the Geology of Canada, 1863, reference is made as has been already stated, to the occurrence of the mineral in the township of North Burgess, and to its occurrence with other minerals in the auriferous sands of the Chaudiere. No other occurrence of the mineral in Canada was made public until the report of its occurrence in the township of Carlow in October, 1896. This may be accounted for by the fact that most people are attracted only by minerals of a metallic lustre, and so pass over those of a "stony" nature. If a part of the energy expended by prospectors in this Province in search for the precious metal had been employed in hunting for other substances, it seems not unlikely that many more valuable and interesting minerals would have been found. It is difficult to get reliable statistics on the production and consumption of corundum. In the Mineral Resources of the United States, 1895 and 1896, a Government publication, it is stated that "The producers of both emery and corundum are averse to giving publicity to their business, and in order to maintain the confidential nature of the statistics the production of the two minerals is stated together." The present selling price of North Carolina corundum quoted in The Engineering and Mining Journal of New York is from $140 to $200 a ton, being at the rate of 7 to 10 cents per pound. Emery is quoted at 1½ to 5½ cents per pound. The corundum and emery produced in the United States in 1895 is stated to have been 2,102 short tons, valued at $105,256, and in 1896 the production was 2,120 short tons valued at $113,246. "The corundum used in the United States is exclusively of domestic production. Emery is imported from Turkey and the island of Naxos, one of the Cyclades group in the Grecian archipelago." The imports of emery in 1895 were valued at $133,038, and in 1896 they had a value of $148,231. The imports of emery into Canada for the last ten years have averaged about $15,000 annually.

The latest advices from Michipicoten, Ont., are to the effect that there is a rush of miners and prospectors in that region again this fall. Several rich strikes have recently been made on the north shore of Lake Wawa.

BLODGETT'S COMBINATION TWIST DRILL, THREAD PITCH, CENTRE AND TAP DRILL GAUGE.

It is with pleasure we present this brief description of one of the most convenient machinists' tools modern ingenuity has developed. This gauge contains the sixty sizes of twist drills from No. 1 to 60; twenty-four thread pitches from 6 to 40; ten tap drill sizes from 2-56 to 18-18; also the centre gauge, and is so constructed that its weight is less than two ounces, making it no larger or heavier than the ordinary pocket knife. This is claimed to be the only convenient pocket drill gauge on the market, as the old style is too heavy to carry. It is made of the best obtainable steel for this purpose, and is case hardened to prevent the holes from wearing by use. The holes are broached to Brown & Sharp's standard and will be found



FULL SIZE CUT.

accurate. The blades of this gauge are utilized for two purposes: the holes being made in the blades for the drills, and the thread pitches cut on the ends, thereby preventing the necessity of carrying an extra tool for that purpose. The numbers indicating the pitches are stamped on the back side of the blade, crosswise, against the thread, so that the desired pitch is easily found. Machinists, like other people, cannot remember every detail, and are often at a loss to know what size hole to drill for a machine screw tap, to get a full depth thread, and, at the same time, to give a sufficient amount of clearance to prevent breaking the tap, for they have learned that a tap will not drill. Ten sizes, ranging from 2-56 to 18-18, are stamped on the back side of the blades, against the proper size drill for that purpose. This gauge is divided into two parts, male and female, which are placed in the back of the gauge and are easily found when wanted. The ordinary centre gauge cannot be carried in the pocket with safety, as the points will soon puncture, and work its way out. No pains have been spared by the manufacturers to make it a perfect, complete and condensed tool. This gauge will be appreciated by those using small tools, as some one of the combined features is in almost constant demand in the large variety of fine machinists' work. For price, etc., see the Aikenhead Hardware Co.'s advertisement on page v. of this issue of The Canadian Engineer.

THE MARINE ENGINES OF THE GREAT LAKES.

Some 1,300 steamers on the lakes have been examined for the Great Lakes Register of Chicago in the past two years. J. C. Coffin has just published a summary of the results of the work, from which we make a few extracts: Of the 1,300 odd vessels surveyed, says Mr. Coffin, we have found 1,150 to be propellers, and a trifle over 50 to be paddle, or side-wheel propellers; the balance being schooners and tow barges, which were equipped with boilers and steam pumps, or hoisting and steering machinery. Of those fitted with screw propellers, we have found that 960 had solid cast wheels, 6 of them being of bronze, 8 of steel and 946 of cast iron; 185 of them had sectional wheels, one of them being bronze, 6 steel and 178 cast iron. Of the entire number, 1,060 of these propeller wheels were fitted on the tail shaft with straight bore and key, while only 74 were fitted on a taper end with feather and nut, the latter arrangement being more modern and considered by most engineers to be the best way of fitting propellers on the shafts. Of the paddle-wheels, we have found 23 to be fitted with feathering floats, and 29 with solid floats. The h.p. non-condensing engine, our earliest type, held the supremacy in numbers up to the end of the decade, 1880 to 1890; this is accounted for in some degree during the latter part of this period, by the fact that there were many tugs and small boats built. The h.p. condensing engine appears but little upon the lakes, there being a total of only 25 in existence. The steeple compound engine had an early start, 22 of them now in existence, having been built earlier than 1870, 62 during the next ten years, and 80 during the period from 1880 to 1890. This type then gave way to the fore and aft compound type and triple expansion type. Of the fore and aft compound type we have five engines built earlier than 1870. This type also reached the height of its popularity during the years 1880 to 1890, and then gave way rapidly to the triple-expansion type, which makes its first appearance during this term with 67 examples, and which has held its supremacy with 147 engines built since 1890. The first quadruple expansion engine was built in 1889, and since that date there have been six vessels equipped with this type of engine, and there are several of this type now under construction. Of the paddle-wheel boats, you will note that 33 engines are of the common and well-known walking-beam type, while 19 are either horizontal or inclined engines.

It is interesting to note the changes which have taken place in the types of boilers. The marine fire box boiler is the most common type, though the Scotch boiler has replaced it rapidly of late years; 731 boilers of this type are in use to-day, 18 of them having been built earlier than 1870, 97 of them between 1870 and 1880, 392 between 1880 and 1890, and only 224 since 1890. The Scotch type of boiler has one example built earlier than 1870, 8 between that and 1880, 193 between 1880 and 1890 and 348 since 1890, a very rapid increase during the last seven years. The marine water-tube boiler is of more recent date, only one having been built previous to 1880. There are now none of this type on the lakes built between 1880 and 1890, but there are 35 vessels built since 1890 equipped with this type of boiler, and there are several vessels under construction which are to be equipped with this type of boiler, and it is the opinion of many engineers that the water tube boiler is the coming boiler for marine use. It is also interesting to note the gradual increase in pressure in boilers built during these several periods. Of those built earlier than 1870, 100 pounds per square inch is the highest pressure, and there is only one vessel of this period carrying 100 pounds, and only one carrying 90 lbs., most of the boilers built during this period carrying from 40 to 55 lbs. Most of the boilers built during 1870 to 1880 carry either 80 lbs., 90 lbs. or 100 lbs. pressure, although there are a few built during this period carrying a much higher pressure, and one carrying as much as 200 lbs pressure. During the period, 1880 to 1890, 276 boilers carry 100 lbs. pressure or less, and 318 carry more than 100 lbs., but there is only one boiler built during this period carrying as high as 200 lbs., 29 carrying 160 lbs., 39 carrying 150 lbs., and the balance ranging from that down to 100 lbs. pressure. Since 1890 the tendency has been to increase the pressure, only 91 boilers being built during this period carrying as low as 100 lbs., while 517 carry higher than 100 lbs. Of this number 75 carry 120 lbs., 82, 125 lbs.; 45, 150 lbs.; 83, 160 lbs., and from that on up to 300 lbs., there being one boiler carrying this highest pressure, 2 boilers carrying 265 lbs., and 12 carrying 250 lbs. pressure.

On Sept. 13th the Mink W. Hanna & Co.'s supply boat was burned to the water line at her moorings, Port Carling. The cause of the fire is unknown. Loss about $1,200; no insurance.

WATER AND HEAT.

AN ADDRESS TO C. A. S. E., TORONTO NO. 2, BY P. TROWERN, TORONTO.

To-night I wish to draw your attention to a tank of water 12 inches square and 12 inches deep, a cubic foot, 1,728 cubic inches or 62.32 lbs. at the temperature of 39 degrees Fahr., which is at its greatest density, that is the molecules or particles of which the water is composed are smaller than at any other degree of heat, and this degree of water is weighed and measured. We will now watch the process of the water freezing and swelling or expanding, not by heat but by the heat leaving it and the cold taking its place; the thermometer standing at 32 degrees, and yet the ice becomes more solid and swelling above our measure, and the mould would burst if it were not allowed to rise—what natural law has been at work to do this? The heat which left the ice is called latent or hidden heat; the thermometer has not revealed it to us for it still stands at 32 degrees. We will now take it out of the mould, and drop it into water at 32 degrees, and find it will float 10 per cent. above the surface. We will measure the cubic foot of water put into the mould and now become ice and find that it measures 1,904¼ inches instead of 1,728 inches. It has gained 176¼ inches or equal to the space of 6.35 lbs of water, a pound being equal to 27.72 cubic inches, or each cubic inch has increased to 1,102 inches. We will now bring the ice back to water and find that we have not lost much, only by evaporation in the air. What was the cause of the ice getting larger than the water we put in the mould as the heat left it. The air kept the molecules apart and enlarged it and yet the thermometer stood at 32 degrees, the same as the water we put in at first.

I here present to you a sketch of the four different states we find water in and we have to handle it to the best of our ability to give motion to our machinery. In one of these compartments we have ice, in the middle one we have water at 39 degrees, the third has water in a boiling state giving off steam into the fourth space, which should be 1,728 times as large as the pound of water in each compartment, while the cold water swells 10 in every 100 lbs. Not by weight, but by measure, the boiling water will measure 1 in 21 or 5 in nearly 100 lbs. or gallons. We will take a pound of water at 32 degrees, put it in a vessel, and put it in, under it a good steady burning lamp, and watch the thermometer standing in it, and find it rises 10 degrees in one minute, this is our unit to work by. We now remove the vessel and put another vessel over the same lamp with a pound of small lumps of ice with a thermometer in it standing at 32 degrees, although the ice is below that degree, equal to our cubic foot of ice—we watch the thermometer, and find that the lamp is sending its heat into the ice, it begins to melt and the temperature remains at 32 degrees until it is all melted, which has taken 14 minutes, at this time we want to know how much heat has the ice received from the lamp to melt it, or how much heat came out of the water, and before it became water again; 10 degrees in one minute will give 14x10 equals 140, yet the thermometer stands at 32 degrees—this 140 degrees is what is called latent heat in ice. We will now proceed to produce steam and find the latent heat in it; let this vessel with the pound of melted ice, now water at 32 degrees, remain over the lamp burning about the same as before; watch the thermometer, and see how it rises, and in 18 minutes it will rise to the boiling point, 212 degrees; 18 minutes by 10 degrees equals 180, plus 32, equals 212. Without disturbing it we will watch and see how long it will take for the water to evaporate, or boil away into steam. We find it has taken 95 minutes or 5½ times as long to leave the vessel in the shape of steam as it did to rise from 32 to 212 degrees, and yet the temperature of the steam gives no indication of rising above 212 degrees; a large amount of heat must have been given off in the 95 minutes; according to our first unit of 10 degrees in one minute, 18 min. by 10 deg. equals 180 deg., 180 multiplied by 95 and divided by 18 is equal to 950 degrees of heat, which have been hidden away in that one pound of steam to make it rise up into its natural element, and to form the clouds which are so useful to us and to the world at large. Had it not been for this beautiful arrangement we would be burnt, and perhaps everything in this world, because clouds are like veils to screen us from such intense heat, and without heat the two gases which form water would remain together as water.

What are these two gases called? Oxygen, 8 lbs., hydrogen, 1 lb., will form 9 lbs. water pure. Unless a great force or energy has been used by some law in nature the water would not have left the vessel, which we left over the lamp. The atmosphere was pressing on the water and keeping it there with a pressure of nearly 15 pounds per square inch, and as soon as sufficient heat had got into it so as to reach 212 degrees, and to cause it to boil and force these two gases to separate or get farther apart, the water or steam rose and passed into the air by means of the visible and latent heat. If we take a vessel with 5½ lbs. of water at 32 degrees, and put a steam discharging pipe with a pound of water changed into steam at 212 degrees, we will find we have 6½ lbs. of water at 212 degrees. Strange to say you cannot weigh heat, it does not seem to have any weight, and the amount that went with the 1 lb. of steam into the 5½ lbs. of water, which changed the 5½ lbs. of water from 32 to 212 degrees became visible heat, but if you take a pound of water at 212 and mix it with 5½ lbs. of water at 32 degrees, we will have 6½ lbs. water at 60 degrees, which shows the amount of heat stored away in the steam. From these figures it appears that 212-60 equals 152 degrees multiplied by 6½ lbs. equals 988 degrees were hidden in the steam. This large amount of heat cannot be destroyed or annihilated, but it is rendered sensible again when the steam is condensed and brought back again to water. The British unit of heat is the quantity of heat that will raise one lb. of water at 39 degrees (on the level of the sea), up 1 degree, that is to 40 degrees. The mechanical equivalent of this heat is of energy or work to raise 772 lbs. weight one foot high, this we are told is the unit of energy of one degree of heat, and before I close this paper I wish to show how some experimenters went to work to find this energy. They made a water-tight box and fitted a paddle-wheel to it with the shaft of the wheel passing through a stuffing box with a pulley on it. The water was weighed and temperature taken, the motion given to the wheel in the box by a weight on a rope around a drum; by the time the water was raised one degree in the box by the motion of the wheel being kept up by the weight it took 772 lbs. weight. This plan was tried and tested in various ways until they became quite satisfied that their figures were correct. The foot pound term has been introduced to express in a convenient way the lifting of a pound to the height of a foot; this is the quantity of heat necessary to raise the temperature of a pound of water one deg. Fahr. being taken as a standard 772 foot pounds, the mechanical equivalent of heat, or by a pound weight to fall 772 feet against the earth, or it would raise 772 lbs. one foot high. It was tried by one of the men to let drop 2 lbs. of water from a height of 386 feet, and when the water had struck the tub to receive it, it had raised ½ deg., or 1 deg. for 772 lbs. The British unit or foot pound was calculated by an engine, the piston having 500 square inches, velocity 200 feet per minute, 500x200x7 is equal to 700,000 or 21 horse units, 1 lb. per minute, one foot high. Suppose 1 lb. of water be taken up in the air 772 feet by evaporation, and it fall into the tub we put to receive it, by the time it has fallen, it has gained one degree; it gives what we require, natural force; it went up by heat, and came down by potential work, and increased in heat.

ACETYLENE ON RAILWAYS.

Some time ago The Canadian Engineer published an article on the use of acetylene gas on railways, describing some developments in which Canadian engineers were in advance of the rest of the world. The following letter from Lt.-Col. J. H. Western, late R. E., inspecting engineer for Government railways of Egypt to P. W. Resseman, Esq., Pontiac Pacific Junction Railway Co., Ottawa, together with Mr. Resseman's reply, which we append, continues the story of the progress of Canadian ideas abroad:

Lt.-Col. Western, writes:

"I am desired by Major Girouard, R. E., president of the State Railways, Egypt, to inform you that he wishes to introduce the acetylene light on his system, and that he has after due enquiry learned that your railway is practically the only one that uses this light. He will, therefore, be exceedingly obliged if you would favor me for transmission to Cairo with full particulars as to system and method employed, results obtained, and where the necessary apparatus can be secured. He learns from the Bulletin of the International Congress that your system up to a year ago was considered most successful, and abso-

lutely free from danger, and being a system of single coach lighting will be eminently suited to his road. Yours faithfully,

"(Signed.) J. H. WESTERN.

"Broadway Chambers, Westminster, London, S. W.

"August 31st, 1898."

The reply of Mr. Resseman was as follows:

"I beg to acknowledge the receipt of your favor of the 31st ult., and am pleased to give you such information as I have in connection with railway car lighting with acetylene gas.

"We have been using the Holland system on the two roads of which I am general superintendent—the Pontiac Pacific Junction and the Ottawa and Gatineau Railway—for nine months. There is really no comparison between the effectiveness of acetylene gas and coal oil for car lighting, with coal oil at 14c. per gallon, and carbide at 5c. per lb., the cost of acetylene gas lighting for railway use is somewhat cheaper than the same lighting by coal oil. I consider that it is the coming light for railways. We have in Canada a problem to face, however, that would not have to be met in any warm country. Owing to the severe frost in winter we have to place the gas generators inside the car to prevent them from freezing. The disadvantage of this lies in the fact that acetylene gas is most difficult to control, and the slightest leak in the generator causes a disagreeable smell in the car. This we hope to overcome, and have been experimenting with better connections from generator to pipe. The gas has no evil effects on the health of a passenger, but, like garlic, the odor is offensive to most persons.

"I find that an ordinary passenger coach, such as we run here, and previously lighted by 14 coal oil burners, can be brilliantly lighted with five 25-candle power burners, consuming each ½-foot per hour. The carbide supplies 5 cubic feet of gas per pound, making the total cost of the lights 2c. per hour, or for a run of hours 20 to 21c. per pair. Of course, there is incidental waste that we cannot get fully controlled. The gas is lost by the vibration of the car, but on the whole the light is efficient and inexpensive. It is absolutely safe as far as fire or explosions are concerned. The gas is generated in small quantities, confined beneath a 7-inch column of water, and any that may escape is so speedily diffused in the surrounding atmosphere that its explosive nature is at once neutralized. In the event of a car turning over the lights go out immediately, and the gas escapes so quickly that fire cannot affect it. So far we have had no accident from acetylene gas, and I cannot conceive how an accident can occur. Say the coach lighted was a sleeping car, 60 feet in length, regulation width, but with all the windows closed, the plant required to light it would generate enough gas to feed 8 to 10 burners of 25 candle-power each, or a consumption of 4½ to 5 feet of gas per hour. If the passengers were all to sleep solidly for ten hours, and the jets were all open discharging unconsumed gas into the car, in ten hours the ratio would be 50 feet of acetylene gas to 4,320 feet of air, sufficient to make a bad smell in the car that would be driven out in half a minute by the opening of a car door. In Egypt or South Africa, where the generators could be placed on the roof or underneath the car, no difficulty would be apprehended from the acetylene gas smell. A railway equipped so that at certain stations, on the arrival of a train, sufficient generators could be taken off and freshly charged ones coupled on, the light could be made continuous. The whole train could be lighted from the baggage car more conveniently than any other way, but for the cutting out or switching of cars. A small closet would hold the plant and connection be made between the cars with hose cocks and rubber hose. This, of course, we cannot use on our lines here. We have three small generators in each car, placed directly over the top inside of the car, of the toilet room. We have experienced very little trouble other than the escape by improper connection, and we hope to entirely overcome this objection in the very near future by obtaining a suitable connection. Low pressure gas is not affected by heat or cold. There are at present scores of patents being issued every month in Canada and the United States for acetylene gas and lamps, and I have no doubt whatever but that in the early future a generator will be invented for railway car use that will be absolutely gas tight, and with the capacity to generate a week's supply of gas for a car without any danger. In the meantime the express trains on the roads of which I have the superintendency have the honor of being the first on the continent, if not in the world, to be lighted regularly with acetylene gas. The generators cost here $12. The carbide is sold here at $4.50 per 100 lbs. What the cost of piping a car in Cairo is you can judge better than I can. In this city it costs about 8c. per foot for the pipe in place; fixtures extra. Pipe used is ⅜-inch for main, and the ¼-inch for connection. Side lights give us the best results. We are using the ordinary gas fixtures, ¼-inch L cocks, porcelain globes with 5-inch rings. I have every confidence in the future of acetylene gas, and advise every railway man to keep posted on its future development. Yours truly,

"(Signed.) P. W. RESSEMAN,

"Ottawa, Sept. 13, 1898." "General Superintendent."

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during August and the eight months ending August, 1897, 1898 :—

	Month of August.		Eight months ending August.	
	1897.	1898.	1897.	1898.
Hardware	£5,876	£2,260	£43,031	£10,550
Cutlery	..	5 095	..	36,404
Pig iron	251	1,027	4,053	8,132
Bar, etc.	796	320	6,595	7,559
Railroad	1,068	..	38,722	23,007
Hoops, sheets, etc	11,159	12,173	42 162	36,642
Galvanized sheets	2,743	7,346	28,201	39,807
Tin plates	7 834	12,774	102 776	98,372
Cast, wrought, etc., iron	2,793	1,779	22,070	20 416
Old (for re-manufacture)	677	..	3 254	3,574
Steel	5,266	2,555	34 803	35,452
Lead	2,933	3,866	13,892	20,3-6
Tin, unwrought	1,232	720	11,411	13,143
Alkali	2,625	3,228	20,274	27,825
Cement	3,365	2,671	11,854	14,993

Industrial Notes.

W. Sterling, brass founder, St. John, N. B., is enlarging his premises.

Galt, Ont., has carried a by-law appropriating $12,000 to building a new town hall.

The Goldie & McCulloch Co., Galt, Ont., will supply the machinery for the new C. P. R. elevator at St. John, N. B.

The Pacific Portland Cement Co., Vancouver, B. C., will, it is said, shortly increase the output of its plant to 100,000 bbls. annually.

Peterborough, Ont., has been supplied by the Wm. Hamton Mnfg. Co., with a stone crusher, which is to be run by electricity.

The Fredericton waterworks have just completed the installation of a large steel boiler of 100 h.p. from the works of E. Leonard & Sons.

Bond & Smith, architects, Toronto, are making alterations and additions to a house on Hayter street, Toronto, which includes heating by hot air.

The offer of the English bondholders to sell the present waterworks to the city of Winnipeg for $275,000 has been rejected by the city council.

The laying of the new 24-inch water main in St. John, N. B., is being rapidly proceeded with under the direction of W. Murdoch, C. E., city engineer.

The McLaughlin Carriage Co., Oshawa, Ont., has ordered a 100-horse power Robb-Armstrong engine from the Robb Engineering Co. Amherst, N. S.

Very satisfactory progress is being made with Mooney Bros', new pulp mill at Mispick, ten miles from St. John, N.B., as the machinery is now being installed.

James Robson & Sons, Oshawa, Ont., are establishing a large tannery in the Cedar Dale premises formerly occupied by Wm. Chaplin, St. Catharines, as a scythe factory.

The Swansea Forging Company is now delivering to Mann, Foley Bros. and Larson, for use on the Columbia & Western Railway of British Columbia, an order for 500 tons of bolts. This is probably the largest order for bolts ever placed with any Canadian manufacturing firm.

D. Miller, Washago, Ont., intends building a saw mill and stave factory this fall.

E. Hanson Greene, P. L. S., Montreal, is making surveys for the projected waterworks for the village of Sutton, Que.

The McLaughlin Carriage Co., Oshawa, Ont., is building an additional building of brick, 150x50 feet, three stories high.

J. D. Ronald has resumed control of the engine building business which he had until a year ago so long carried on in Brussels, Ont.

London, Ont., finds that the cost of its new hospital is increasing as the building progresses; already there is a $20,000 deficit in sight.

The Robb Engineering Co. is building a 60-h.p. boiler for Wm. Curry & Son, Windsor, N. S., and a 30-h.p. for W. C. Hatfield, Parrsboro, N. S.

The village of Andover, N. B., is installing a system of water supply for fire and domestic purposes. The contract has been let to J. B. Porter for about $8,000.

The contract for the concrete substructure of the new bridge over the Ouse in Asphodel township, Peterborough county, Ont., has been given to Wm. Langford.

Bond & Smith, architects, Toronto, have just started to build a church for the parish of Saint Clement, Toronto. The corner stone will be laid on October 8th.

W. J. Campbell, Boston Mills, Ont., has lately bought the Oshawa, Ont., Roller Mills, and is replacing all the old machinery with new and up-to-date appliances.

A large number of Sterling Hack Saw Blades are being sold by the Aikenhead Hardware Co., Toronto. Samples can be had and prices will be quoted on application to them.

An explosion in the mixing room of one of the Hamilton Powder Co.'s mills at Belocil, Que., totally destroyed the building, Sept. 16. No lives were lost, nor was any damage done to surrounding buildings.

The foundation stone of a new five-story building to be added to the buildings of George E. Tuckett & Son Co., Ltd., has been laid. The building is to be used exclusively in the working of Canadian-grown tobacco.

We understand that T. H. Watson is retiring from the firm of Leather & Watson, Hamilton, and will devote himself entirely to the interests of the Swansea Forging Company, of which he has been manager for several months past.

The officers of Brantford, No. 4, Canadian Association of Stationary Engineers are: A. Ames, president; T. Pilgrim, vice-president; O. S. Merrill, secretary; C. A. Walker, treasurer; A. McKinnon, doorkeeper; J. Nichol, conductor.

The boiler in a brickyard owned by F. W. Entricken, on the 16th concession of Zorra, Oxford county, Ont., exploded Sept. 7th, and instantly killed a young man named Aikens, 19 years of age. The building was badly damaged, and another workman was slightly injured.

The good roads propaganda carried on by A. W. Campbell, Provincial Road Instructor for Ontario, has had excellent results, and this season streets have been built on the most approved plan in the following towns: Berlin, Chatham, Collingwood, Owen Sound, Brockville, Kemptville, Woodstock, Ingersoll, Stratford, Galt, St. Catharines and Lindsay.

We hear that Samuel Siggins, bicycle rim manufacturer, at Woodstock, is in difficulty, and that his banker has taken possession of his assets, which were mortgaged. He began as a carriage maker in 1888. About six months ago he claimed a surplus of $16,500 over liabilities of $3,500, but his assets consisted largely of real estate and machinery, hence his present trouble.

The closing session of the Ontario Association of Executive Health Officers was held in Ottawa, Sept. 27th, and the officers for the next year were elected as follows: President, Dr. J. J. Cassidy, Toronto; vice-president, Dr. Hutcheson, London; secretary-treasurer, Dr. J. J. Mackenzie, Toronto. Council—Dr. W. F. Vanbuskirk, Stratford; Dr. Fee, Kingston; Dr. Robillard, Ottawa; Dr. Wardlaw, Galt; Dr. Hall, Chatham; Dr. McCrimmon, Palermo; Dr. Sheard, Toronto. Good Roads Committee—Chairman, A. W. Campbell, C. E., Toronto; A. McGill, Ottawa; E. B. Shuttleworth and J. J. Mackenzie, Toronto; Capt. Vanbuskirk, Stratford; Dr. P. H. Bryce.

Peterborough, Ont., will lay 6,000 feet of 12 and 15 inch sewers.

The thriving village of Grande Mere, Que., is to have a waterworks to cost $40,000.

The Waterville, Que., Furniture Co., which was recently burned out, is looking for a bonus and a location.

F. A. Hibbard, C. E., Ottawa, is superintending the building of the new bridge over the Madawaska at Arnprior, Ont.

Bothwell, Ont., will build a firehall, lockup and council chamber as an addition to the town hall to cost about $2,000.

The main drainage by-law carried in Ottawa, Sept. 8th, by a majority of over 250. The amount involved is $425,000.

The W. R. Gardner Tool Co., Sherbrooke, Que., is finishing up what orders are on hand, after which the works will be closed down.

An effort is being made by English capital to control the manufacture of carriage wheels, hubs, spokes and bent wood stuffs in Canada.

The Sackville Machine & Foundry Co.'s shops, Amherst, N. S., are now running under the management of L. G. Holder of St. John.

F. C. Freeman, C. E., has made an estimate of $100,000 for a water supply system for Chatham, Ont., proposing to take the water from Morrison brook.

The waterworks commissioners of Rat Portage, Ont., have taken over the works from Secretran & O'Boyle, the contractors, and will complete the work themselves.

The Coulthard & Scott Co., Limited, Oshawa, Ont., manufacturers of agricultural implements, have this summer had a large two-story brick addition built to their works.

The progressive village of Verdun, Que., is to have a system of sewers and a water supply. McConnell & Marion, civil engineers, Montreal, are getting out the plans, and will superintend the work.

Stratford, Ont., is still undecided as to the method of sewage disposal to adopt. On one hand the town is threatened by the Provincial Board of Health, and on the other by the adjoining municipalities, and so must very soon install a system of some sort.

E. N. Page, G. H. Page, Cohoes, N. Y.; D. H. Friedman, Albany, N. Y.; R. Hersey, J. C. Hodgson, W. W. Near, Montreal, have applied for incorporation as the Page-Hersey Iron and Tube Company, Ltd. The chief place of business is to be St. Henri, Que.; capital, $50,000.

W. W. LaChance, architect, Hamilton, Ont., has prepared plans and specifications for a steel and concrete dam at Stoney Creek. The proposed structure has double retaining walls. Pipe will be laid and connection made with the reservoir formed for fire protection.

It is reported that the Sturgeon Falls, Ont., Pulp Co., has acquired from the Ontario Government the right to take pulp wood along Sturgeon river for 20c. per cord. A further consideration is the agreement by the Pulp Co. to spend at least $1,000,000 on buildings in connection with paper and pulp mills.

The Imperial military authorities at Halifax have completed the purchase of a large piece of water front land at McNab's Island at the entrance of Halifax harbor, and will commence at once the construction of a large fort. It will be one of the largest in the Dominion of Canada, and mounted by the most modern and powerful guns.

The Deseronto Iron Co., Ltd., of which F. B. Gaylord, formerly manager of the Gaylord Iron Co., Detroit, is general manager, is making excellent progress with the works now building in Deseronto. All the charcoal produced by the Standard Chemical Co. will be used in smelting, and the chemical company will very greatly extend its operations.

Among institutions teaching by correspondence are the International Correspondence schools, Scranton, Pa., well organized and well equipped with a large staff of instructors. The schools have met with extraordinary success since their establishment in 1891 in teaching machine design, steam engineering, electricity, architecture, mechanical and architectural drawing, mining, plumbing, heating, and ventilation, chemistry, bridge, railroad, municipal, and hydraulic engineering, sheet-metal pattern drafting, English branches, book-keeping and stenography.

William Lavers, contractor, Montreal, has the contract for the public hall, Westmount, Que. Work will be commenced at once.

On Sept. 23, Stirling, Ont., gave the waterworks by-law for $20,000 a majority of 51. Gravitation will bring water from Somerset Lake, elevated nearly 300 feet and distant two miles.

The building trade in Toronto has had a revival this year after several seasons of depression. In 1896 the building returns showed only $657,168, and last year the business was only $938,619. Up to August 25, 1898, the returns amounted to $1,176,890.

S. C. Skinner, F. J. Skinner, A. Louise Skinner, Gananoque, Ont.; J. F. Chapman, E. Chapman, Deseronto, Ont., have been incorporated as the Skinner Company, Ltd., to manufacture carriage hardware and do a general iron and brass foundry business; capital, $75,000; chief place of business, Gananoque, Ont.

The International Silver Company has been formed under the laws of the State of New Jersey, with a capital stock of $15,000,000 preferred and $15,000,000 common stock. The combination is said to have absorbed the leading manufacturers of silverware on the continent including the Standard Silver Plate Co., Toronto.

Stratford, Ont., has decided to grant the Whyte Packing Company of Mitchell, Ont., exemption from taxation for 20 years and guarantee their 4 per cent. debentures to the amount of $30,000 for 20 years, on condition that they erect a pork-packing and curing factory at a cost of $40,000 to $50,000, and employ 75 to 100 men.

Aemilius Jarvis, architect, Toronto, has returned from New York, and announces that the lease for the site of the large new hotel on King St., east, Toronto, has been signed, and that he has interested New York capital in the venture. The plans have been prepared and the promoters state that the building will be at once gone on with.

Dr. Sheard, medical health officer of Toronto has issued a report on sewage, which is very interesting and quite comprehensive as far as it goes, but the many new ideas brought forward in the past eight years are overlooked. No doubt we shall have a second report from Dr. Sheard bringing his really valuable publication up to date.

The incorporation of the great steel trust, to be known as the Federal Steel Company, has been completed in New Jersey. It is the largest company ever admitted under the laws of New Jersey, its paid up capital being $200,000,000. An incorporation tax of $40,000 was paid to the Secretary of State. The location of the principal office of the company is stated to be in Jersey City.

The Maritime Sulphite Fibre Co., Chatham, N. B., has ordered a 500 h. p. cross compound condensing engine from the Robb Engineering Co., Amherst, N. S., to replace the present 250 h.p. simple engine, and to provide for contemplated enlargements of the plant. The new engine is expected to effect a large saving in fuel over the type now used as well as to give much better speed regulation.

A point of special interest in the export of iron plates from Chicago to Belfast, Ireland, is the fact that Harland & Wolff, ship-builders of Belfast, were boycotted by the steel manufacturers because that firm agreed to the terms of the striking engineers some time ago. As no steel could be secured in Great Britain the firm ordered from America. It remains to be seen whether a trade begun under such favorable circumstances can maintain itself under changed conditions.

W. F. Tasker, business manager of the Don Valley Brick Works, stated recently that the works are the largest and most efficient brick-making plant in America. While all kinds of brick are manufactured at this immense plant, pressed brick, enamelled ware, terra cotta, porous terra cotta, flooring, tiles, in all over 300 patterns and street-paving brick are made. This year they have already made 10,000,000 brick, and are now running night and day to fill orders. The prices range from $6.50 for the ordinary brick up to $400 for some of the finer work. A considerable amount of brick was sold in Toronto, and more has been shipped to points from St. John's, Newfoundland, to Vancouver, B. C. The plant is kept running the year round, and employs on an average 80 men. It is situated on the west side of the river Don, just on the eastern limit of the city, and comprises 1,700 acres. The material is practically inexhaustible. In the plot is a shale bank, from which all the red brick is made, three-fourths of a mile in width, two miles in length and 900 feet deep.

Electric Flashes.

The city of Winnipeg has decided to appoint an official electrician.

Brantford, Ont., had its new electric lighting plant put into operation on the 10th of last month.

A second generator is being put in at the Cataract Power Company's works at Decew's Falls, Ont.

The Maritime Electrical Association held its first annual convention on Sept. 27th and 28th in Halifax, N. S.

The town council of Thorold has decided to postpone the submission of the by-law for the $7,000 lighting plant till January next.

The C. P. R. telegraph copper line was completed Sept. 21st from Montreal to Vancouver. This is the longest telegraph line in the world.

The Vankleek Hill Electric Light Co., Vankleek Hill, Ont., is increasing its lighting capacity by the installation of a 50 k.w. S. K. C. two-phase generator.

Fire broke out simultaneously in Nos. 305, 306 and 310 Peel street, Montreal, one night recently. The fire was started by the burning out of part of a lighting fixture.

Municipal ownership of the electric lighting plant in Pembroke, Ont., is being actively canvassed, and there appears to be a strong probability of its being carried out.

The Montreal Street Railway Co. lost over $200,000 by a fire on Sept. 16th, which destroyed a car shed containing 60 cars and seven sweepers. The insurance very nearly covered the loss.

The Canadian Pacific Railway have purchased from the Royal Electric Co., a 50-light 2,000 candle-power arc dynamo, together with 52 arc lamps, for use in their car shops at Hochelaga.

The Warwick Clothing Manufacturing Company of Warwick, Que., is lighting its works throughout by electricity. The order for the necessary apparatus has been given to the Royal Electric Company.

Wm. Kennedy, jun., C. E., of Montreal, is preparing plans for the hydraulic portion of the proposed scheme for bringing power from Ragged Rapids to that town, a distance of about 12 miles. It is thought the entire enterprise would cost about $70,000.

The Citizens' Electric Light Co., of Smith's Falls, Ont., is increasing the electric lighting plant, and has purchased from the Royal Electric Co., a 1,500 light royal incandescent dynamo, with station apparatus complete. This is to be installed at once.

The carborundum works at Niagara Falls, Ont., are now steadily turning out a product of the highest class. It is the intention of the company to very materially enlarge their premises by the erection of an additional building, about twice the size of the present. It is to be one and two stories high.

A United States company which is going to develop the water power of the Jacques Cartier river for electric light and power purposes for Quebec city in opposition to the Montmorency Company, has acquired the chartered rights as regards Quebec of the Standard Light and Power Company, Montreal. It has a capital of half a million, and its president is Emerson McMillan, of New York.

The Niagara Central Railway has been bought by Haines Bros., New York. The road will be converted into an electric road, and it is said there will be a 40 minute service between St. Catharines and Niagara Falls. The trestle work at Merritton and Thorold will be done away with, and the road run on the ground, the motor cars being able to overcome grades which steam cars could not do. The Grand Trunk at Merritton will be crossed on the level by means of interlocking switches. The plans also include the extension of the road.

Galt, Ont., has carried a by-law to buy out the Galt Gas & Electric Light Company, and operate it as a municipal plant.

William Barber Bros., Georgetown, Ont., recently ordered from the Canadian General Electric Company, a 6 k.w. 500 volt motor.

H. Vick & Sons, Orillia, Ont., recently ordered from the Canadian General Electric Company a 50 light incandescent dynamo.

The Midland Elevator Co., of Midland, Ont., is having placed in its elevator a fifty light T.-H. dynamo, from the works of the Royal Electric Co.

New Westminster, B. C., has ordered from the Canadian General Electric Company a 100 light incandescent dynamo, and a 6 h.p. 500 volt motor.

The Deseronto Iron Company, Deseronto, Ont., has closed a contract with the Canadian General Electric Company for a 200 light dynamo with marble switchboard.

The Bells Asbestos Company, of Thedford Mines, Que., has ordered from the Canadian General Electric Company a 100 light dynamo to be installed at Thedford Mines.

The Provincial Asylum at Fairville, N. B., has placed an order with the Canadian General Electric Company for a 6 k.w. motor, and one 8½ k.w. motor of the Edison bi-polar type.

Boivin, Wilson & Company, Montreal, have recently ordered from the Canadian General Electric Company a 100 light incandescent dynamo for their premises at Berthier, Que.

The Hamilton Electric Light and Power Co., has lately placed in its lighting station one 2,000 light Royal alternator, and one 100 h.p. 250 volt direct-current Royal power generator.

The British Columbia Sugar Refinery Company, Vancouver, B. C., has recently ordered from the Canadian General Electric Company, a 25 k.w. generator of the well-known multipolar type.

The Montreal Cotton Company, Valleyfield, Que., in addition to the very large increased order placed in August, has given a further order to the Canadian General Electric Company for a 150 h.p. induction motor.

The British Columbia Electric Railway, in order to meet the increased traffic over its road, recently placed an order with the Canadian General Electric Company for additional car equipments of the well-known C. G. E. 1,000 type.

The Canadian Electric & Water Power Co., Perth, Ont., is installing a 5-h.p. two-phase S. K. C. motor. This is the third installation within a short time, and shows what can be done with the poly-phase system, for developing a power trade for electric light companies and assisting to make the much desired day load.

The West Kootenay Power and Light Company, which is building a parallel line of wires between Rossland, B. C., and the generating plant at Bonnington Falls, has the right of way cut, and poles on the ground for most of the distance. The right of way has been cut clear of everything for a width of 100 feet, and all the tall trees outside of that area, which, if they fell, would injure the line, have also been cut down. The insulators will be housed so as to keep out the snow in winter. The idea in constructing the second line is so that if one line goes down the other can be used and interruption of the service prevented.

The September number of the Street Railway Journal has been made a souvenir of the Boston convention of the American Street Railway Association, and is a quite unusual publication in size, in typographical appearance, and in the character and quality of its reading matter. Among the special features are: "Street Railway Conditions and Financial Results in Metropolitan Boston," which is devoted to a financial analysis of thirty-one street railway properties in and about the city of Boston. These are suburban and interurban in character, and a comparison of their financial characteristics is of interest to street railway capitalists. The Boston Subway is described in considerable detail, the latest plans of the subway and subway stations as finally carried into effect. Proposed New Electric Elevated Railway in Boston is a brief article on the proposed construction. There are also several special contributed articles in which many will be interested, together with descriptions of many new improvements in electric railroading.

Munderloh & Co., Montreal, recently ordered from the Canadian General Electric Company a 12 k. w. incandescent dynamo.

J. H. Head, Hagarsville, Ont., has recently ordered from the Canadian General Electric Company, a very compact lighting plant. The generator will have a capacity of 50 lights.

Tromanhauser Bros., Goderich, Ont, have placed an order with the Canadian General Electric Company for a 200 light incandescent dynamo, which they propose to install to light their elevator buildings.

The Canadian Pacific Railway smelter at Trail, B. C., recently placed an order with the Canadian General Electric Co. for a 50 light 2,000 c.p. brush arc dynamo, together with the necessary lamps. These are to be used at the smelting works at Trail.

John Ballantine & Son, Preston, Ont., have given a contract to the Canadian General Electric Company for a lighting plant, including a 100 light dynamo with instruments. The order includes the wiring up of their premises for use of incandescent electric lighting.

The Linde British Refrigeration Company, Montreal, has recently ordered from the Canadian General Electric Company a 15-h.p. three-phase induction motor. The power will be supplied to this induction motor from the circuits of the Lachine Rapids Hydraulic & Land Company.

The Peoples' Electric Company, Windsor, Ont., owing to the very large and satisfactory increase in its lighting business has recently placed an order with the Canadian General Electric Company to supply it with a 2,000 light iron-clad ventilated armature type single-phase alternator.

The city engineer of Toronto has refused to draw up specifications for a 6,000 h.p. municipal power plant as ordered by the council, and has recommended that $1,000 be appropriated to secure the services of an expert consulting electrical engineer, who would draw the specifications.

The Royal Electric Company has sent to its friends a very fine photo, 14x21 inches, of the group taken on the occasion of the visit of the Canadian Electrical Association to the power-house at Chambly, Que. The picture is taken in front of the power-house, and makes a very interesting souvenir.

The War Eagle Consolidated Gold Mining Company, Rossland, B. C., has ordered from the Canadian General Electric Company, two 2-h.p. induction motors, and one 10-h.p. induction motor. The power to operate these induction motors is to be furnished by the West Kootenay Power & Light Company.

The Peterborough and Ashburnham, Ont., street railway was sold by the sheriff, Sept. 12th, under an execution for fifty odd thousand dollars. The purchaser was Arthur Stevenson, and the price paid $20,000. It is understood that Mr. Stevenson acted for some of the largest stockholders in the present directorate. The sale will not affect the operation of the road at present, as it will be run as heretofore until some further arrangements are made.

The T. Eaton Company, Ltd., Toronto, has given an order to the Canadian General Electric Company for the installation of a 130 k.w. direct connected generator, with marble switchboard, containing the necessary instruments for the generator. When this generator is installed the T. Eaton Co. will have three 130 k.w. generators, and two 50 k.w. generators of the Canadian General Electric Company's well known direct connected direct current lighting generators.

E. S. Jenison is promoting a scheme of power development on the Kaministiquia river to supply Port Arthur, Ont., and Fort William. The proposal is to build a water-power canal from above the Ecarte Falls on the Kaministiquia river to the boundary of Port Arthur, where a storage reservoir will be built. The water will be delivered with 300 feet head. The intention is that the towns of Port Arthur and Fort William shall get their water supply from this source, which will likewise give them a fire pressure by gravitation. Both towns are to be supplied with water sufficient to generate electricity to supply the Port Arthur electric railway, and the lighting plants. The company is to have the right to furnish water-power, compressed air, and electric power to the manufacturing institutions in the two towns.

The Canadian Oiled Clothing Company, Toronto, has recently found it necessary to increase its factory premises, and has removed from Port Hope, Ont., to Toronto. An order has been given to the Canadian General Electric Company for the installation of a 100 light incandescent lighting dynamo.

The Hamilton Blast Furnace Company, Hamilton, Ont., has given a contract to the Canadian General Electric Company for the installation of a 150 light incandescent dynamo with switchboard and the necessary instruments, and is also having the factory wired up for the use of incandescent lights and long burning direct current arc lamps.

An evidence of the improvement in business conditions attending the manufacturing and other interests throughout Canada is markedly indicated by the large number of isolated electric lighting plants being installed this season and the many increases in the generating capacity for both lighting and power work, which are being made in central station plants.

D. A. Gordon, Wallaceburg, Ont., who has secured a franchise for the installation of an incandescent electric lighting plant in the town of Tweed, Ont., has recently given an order to the Canadian General Electric Company for one of their 500 light single phase alternators. The order also includes the necessary material for the erection of a complete lighting plant.

Jay P. Graves, manager of the Big Three Gold Mine Company, Rossland, B. C., has just placed an order with the Canadian General Electric Company for a 75 k.w. synchronous motor. This motor is to be used in the development of the mine at Rossland, and the current for its operation will be derived from the power circuits of the West Kootenay Power & Light Company.

Judge Tellier has recently rendered judgment in the case of Mrs. Dominica Delvero against the Montreal Park and Island Railway Company. The plaintiff, who resides in Italy, claimed, in her name, and in the name of her five children, $5,000 damages on account of the death of her husband, who was killed while working in the service of the defendant company. Delvero was employed with a gang of other men in the construction of one of the company's lines. A platform car was used to carry rails from one point to another, and the men were in the habit, although against the rules, of getting on this car and allowing it to slide down the grade, when going for rails. On the day when the accident occurred, a big branch had been cut down from a tree, and was lying across the track, and as the men coming down on the platform car could not prevent a collision, having no brake, they jumped off. In doing so, Delvero sustained injuries from which he died two days after. His widow then took out the present action. In rendering judgment, the Court held that it had not been proved that the deceased had been made aware of the rule forbidding the men to get on the platform car. Moreover, this order seemed to be pretty much a dead letter, and the use of the car for the convenience of the men themselves seemed to have been tolerated. Under these circumstances the company must be held responsible for the accident. In the absence of sufficient proof, the Court assessed the damage at $1,000 and rendered judgment in favor of the plaintiff for that amount.

Mining Matters.

The Canadian Gold Fields Co., Deloro, Ont., has ordered a 50-h.p. tandem compound engine from the Robb Engineering Co., Amherst, N. S.

Notwithstanding the closing down of the mines on Labor Day the ore shipments from Rossland, B. C., for the week were very heavy— Le Roi, 2,277 tons, War Eagle, 1,233; Iron Mask, 66.

H. H. Eames' process for treating arsenical ores was tested at Actinolite, Ont. The experiment is said to have proved a success and the results are so satisfactory that operations will be immediately commenced on an extensive scale.

A. E. Carpenter, Hamilton, and Jno. Patterson, are developing a mine of magnetic iron ore on the Kingston and Pembroke. W. G. Walton, Hamilton, Ont., has also discovered a vein of magnetic ore. Both have been tested and favorably reported on by the experts of the Hamilton, Ont., Blast Furnace Co.

Rich finds of gold are reported from the Hootalinqua River, Yukon Territory.

There is considerable excitement in British Columbia over a find of placer gravel on Rover Creek near Slocan Junction. Gravel is said to have been found giving 75 cents to the pan, and during the first day or two after the discovery no less than eleven claims were located.

Andrew Bell, C. E., Almonte, Ont., has prospectors at work in the iron mining regions of Darling, Lanark county, Ont., and is preparing a map, showing the sections which are of value, with the ultimate object of shipping the ore to the new smelting works at Deseronto, Ont.

The recent discoveries of hematite in the Madoc district, Hastings county, Ontario, have led to a proposal to re-open the G. T. R. branch line from Madoc to the C. O. R., which has been disused since the Wallbridge mine, in the neighborhood of the recently discovered mines, became exhausted.

Zinc is advancing from $30 to $33 per ton, coming within $1 of the highest price on record, which was reached a month ago. The present advance is attributed to the increasing demands for zinc ore. New mines are being opened all over the districts and many old abandoned mines are again being worked.

The Bruce Mines, Ont., the great copper property out of which $1,000,000 worth of metal was formerly taken, has been purchased and paid for by a syndicate formed by Lord Douglas of Hawick. The work has been pronounced by experts to be sufficient to demonstrate the fact that very large and rich copper veins run from Bruce Mines in a northwesterly direction towards Lake Desbarats.

At a meeting of the Board of the Iron Miners' Association of Ontario, held recently, R. C. Clute, Q. C., was elected president in the place of Hon. Senator McLaren, who could no longer continue to perform the duties of the office. Mr. Clute is interested in one of the few Ontario mines that have done an export trade, but it is closed at present on account of lack of transportation facilities. The secretary of the association reports that almost daily enquiries are being received from Great Britain as to the prospects of iron mining here and our ability to supply the British market. He also reports that mining properties are in more active demand and several fine properties have recently been acquired by members of the association.

The new Atlin gold fields in British Columbia are said to be more extensive than those of the Klondyke. No creeks as rich as El Dorado have been found, but on six or seven creeks claims are paying $20 per day per man above expenses. The results are being obtained above bedrock, which has been reached only in few instances. Since July mining has been in progress on Pine and Spruce creeks, emptying into Lake Atlin. Within the last few weeks rich discoveries have been made on Boulde or Musket Wright, Birch, Moose and Surething creeks, and on large glacial moraines. Near Pine Creek wonderfully rich bench claims are being opened on moraines, which are the piles of gravel and sand brought down by the glaciers from the higher ground.

Though it might be very unwise to place too implicit reliance upon the reported extent and value of the recent gold find in Queen Charlotte Islands, of British Columbia, yet it is well to recall the fact that the first authenticated discovery of gold within the limit of what is now the Province of British Columbia occurred at Mitchell's, or Gold Harbor, on the west coast of these islands, in 1857. According to Dr. Dawson, at least $20,000 worth of gold was obtained at this point, but the amount has been estimated as high as $75,000. The same authority states that no paying gold placers have been discovered on the islands, but the precious metal has been found not merely in the nugget form, but existing in numerous quartz veins of small extent in various localities. It is also present in fine scales in deposits of magnetic iron ore, in the neighborhood of Cape Fife. As a matter of fact, the mineral producing possibilities of these islands cannot be regarded as satisfactorily ascertained.

A tunnel 3,000 feet long is to be driven on the Columbia & Western railway, now a part of the Canadian Pacific system, about three miles from Brooklyn, B. C., and at an altitude of about 2,000 feet above the Columbia river. Its dimensions are 3,000 feet long, 21 feet high and 16 feet in width, and it will require the excavation of about 28,000 cubic yards or 85,000 tons of syenite, which is the prevailing rock of the mountain. It

will take about ten months to drive this tunnel, although the other portion of the line will be completed before that time. During the driving of the tunnel, trains will be transported over the divide by means of a series of ten switchbacks, which will be abandoned when the tunnel is completed. McLean Bros. have the contract under Mann, Foley & Larson, and have purchased a large Ingersoll-Sergeant plant from the James Cooper Manufacturing company of Montreal, consisting of two large compressors, 14 air drills, boilers, pipe line, etc., the cost of which when installed will be about $22,000. The tunnel will be driven from both ends and the driving should progress at the rate of from 8 to 10 feet per day on each end.

The Regina mine in the Rainy River district, which is owned by a close English corporation of which Sir Henry Wilkinson is the head, is the deepest mine in Ontario, the main shaft being down 434 feet. In addition to the shaft, says The Rat Portage Miner, the mine has over 2,000 feet of drifting, the longest drift being 400 feet. On the seventh level drifts are being run on each side of the shaft, and at present both heads are in fair ore. The bottom of the shaft was in good ore, when sinking was discontinued for the present, as ground enough is now opened to keep the mill running for a long time. A drift is being run under the lake on the sixth north level with good success. Stoping is now being done on the upper levels, and last week some phenomenally rich stuff was struck. The company have recently put in a battery of seven Tremain stamp mills, equal to about 35 stamps of the gravity pattern, which supplanted the old 10-stamp mill. The new plant is said to be giving good satisfaction, and is treating from 1,800 to 2,000 tons of ore a month. The production of gold bullion, while not stated, is said to be entirely satisfactory to the owners, and the mine is on a paying basis. A considerable percentage of the ore is of the concentrating quality, which condition has necessitated the putting in of concentrating machinery, consisting of two 3 compound Hartz gigs, which do very good work. The mine is also equipped with a 16-drill Ingersoll-Sergeant compound condensing compressor plant. The shaft is simply a development shaft, and the company now think that in a very short time they will sink a new vertical and permanent shaft, which will mean the expenditure of many thousand dollars, but the output of the mine warrants the undertaking.

Brief, but Interesting.

A new and highly important invention was tested at the German manoeuvres this autumn. It was in the shape of a Greek Phoenician fire, invented by a Berlin engineer. It ignites on contact with the air or water and cannot be quenched by either water or other things. It burns with a brilliant flame, and it can be sunk under water or under ground and when brought to the surface instantly bursts into flame at any desired point. It was tested during the night, off the island of Heligoland and off Kiel and proved most efficient in detecting the presence of the enemy.

At the annual conference of the Association of Municipal and County Engineers in Edinburgh, a short time ago, Donald Cameron, city surveyor of Exeter, Eng., the inventor of the septic tank system of sewage treatment, read a paper, in which he said that one of the most notable points observed in the Exeter tank had been the hitherto unrecognized energy stored in sewage, as evidenced by the production of marsh gas. The works and public paths adjoining Exeter had been lit with the gas. He had not had more than ten such lights burning at one time, but it was apparent, even under the conditions of leakage existing, that more than twice this number could be kept constantly alight, and this estimate was made during the cold, wet weather of last winter. The gas was innocuous, and could only be detected ordinarily by applying a light.

It now appears that some bodies, even without special stimulation, are capable of giving out rays closely allied, if not in some cases identical, with the Roentgen. Uranium and thorium compounds are of this character, and it would almost seem from the important researches of Dr. Russell that this ray-emitting power may be a general property of matter, for he has shown that nearly every substance is capable of affecting the photographic plate if exposed in darkness for sufficient time. No other source for Roentgen rays but the Crookes tube has yet been discovered, but rays of kindred sorts are recognized. The Becquerel rays, emitted by uranium and its compounds, have now found their companions in rays—discovered almost simultaneously by Curie and Schmidt—emitted by thorium and its compounds. The thorium rays affect photographic plates through screens of paper or aluminum, and are absorbed by metals and other dense bodies. They ionise the air, making it an electrical conductor; and they can be refracted and probably reflected, at least diffusively. Unlike uranium rays, they are not polarized by transmission through tourmaline, therefore resembling in this respect the Roentgen rays. Quite recently M. and Mme. Curie have announced a discovery which, if confirmed, cannot fail to assist the investigation of this obscure branch of physics. They have brought to notice a new constituent of the uranium mineral pitch-blende which in a 400-fold degree possesses uranium's mysterious power of emitting a form of energy capable of impressing a photographic plate and of discharging electricity by rendering air a conductor. It also appears that the radiant activity of the new body, to which the discoverers have given the name of Polonium, needs neither the excitation of light nor the stimulus of electricity; like uranium, it draws its energy from some constantly regenerating and hitherto unsuspected store, exhaustless in amount. It has long been to me a haunting problem how to reconcile this apparently boundless outpour of energy with accepted canons. But as Dr. Johnstone Stoney reminds me, the resources of molecular movements are far from exhausted. There are many stores of energy in nature that may be drawn on by properly constituted bodies without very obvious cause. Some time since I drew attention to the enormous amount of locked-up energy in the ether; nearer our experimental grasp are the motions of the atoms and molecules, and it is not difficult mentally so to modify Maxwell's demons as to reduce them to the level of an inflexible law and thus bring them within the ken of the philosopher in search of a new tool.

The "gold from sea water" enterprise of the Electrolytic Marine Salts Co., of North Lubec, Me., has suspended operations and the "inventor" of the process and manager of the company, "Rev." P. F. Jernegan, has absconded, it is reported in The Engineering News, after having received $338,000 of the "profits," which were derived not from sea water but from the stockholders. He sailed for Europe under an assumed name after having converted about $100,000 cash into government bonds in New York city, and his arrival at Havre on his way to Paris has been reported by cable. Steps have been taken to have him shadowed by detectives in France until papers can be sent charging him with embezzlement, on which his extradition may be secured. It is said that about $300,000 out of the $10,000,000 capital stock of the company was subscribed for in Newburyport, Mass., by bank directors and leading business men, who were led to subscribe through their confidence in the judgment of A. P. Sawyer, a local capitalist, and W. R. Usher, a large shoe manufacturer of that city, both of whom were directors in the company. One report says that $2,400,000 of the stock has been sold at par, that 45 per cent. of the money received went to the promoters, 20 per cent. to the "financial agents," and the remaining 35 per cent. into working capital, some of which was expended in the construction of the works at North Lubec, upon which 600 men have been engaged. The New York Herald of July 31 gives an interesting account of the preliminary experiments of the "inventor," near Providence, R. I., by which he obtained his first contributions of capital. It appears that a small shed was built at the extremity of a long slender wharf projecting from the shore of Narragansett Bay, and through a hole in the floor there was lowered by means of a windlass a large box containing a pan of mercury. An electric battery supplied by the "inventor" was applied during a whole night in the presence of some capitalists from Middletown, Conn., who had brought with them the mercury. The next morning the mercury was lifted from the water and given to a chemist who assayed it, and found in it $4.50 of gold, and thereupon the capitalists, much pleased, paid the first instalment on their investment. The deception in the experiment, according to the detective, consisted in a diver's proceeding under water during the night to the box, pouring out the mercury, and substituting for it another lot of mercury containing gold. Upon this basis was floated the $10,000,000 company. Its suc-

cess in obtaining gold at North Lubec was attested by its sending frequently to the New York Assay office "gold bricks" containing each about $2,000 of gold, and the exhibition of similar bricks at the company's office in Boston. The "gold from sea-water" scheme thus appears to have been one of the most gigantic swindles of recent years. It was similar in many respects to the Electric Sugar Refining swindle in New York city in 1884, by which many prominent business men, including even sugar refiners, were victimized. One of the operators in that scheme was convicted and sentenced to nine and a half years' imprisonment. It is to be hoped that a like fate will meet the Rev. Jernegan and his accomplices.

Railway Matters.

Truro, N.S., has voted $30,000 to the Midland Railway Co., on condition that the road enter Truro by way of Clifton instead of joining the C. P. R. at Brookfield,

The surveyors engaged in locating the Southeastern Railway have reached the War Road harbor in Minnesota, and expect to be at Rainy River within five weeks.

The contract for the superstructure which is required to permit the removal of the obstruction at the Sault Ste. Marie canal has been awarded to the Dominion Bridge Company.

Emile and Jean Stehelin, proprietors of the Weymouth and New France Railway, Digby county, have ordered another locomotive from the Robb Eng. Co., Amherst, N. S., for their pole railway.

Arthur White, assistant general freight agent of the G. T. R., has recently inspected the disused Madoc and Eldorado branch of the Grand Trunk, and states that the company will not reopen it to aid the development of iron mines unless they can obtain Government assistance. The line has been closed for years, and will require a good deal of reconstruction.

The C. P. R. is building at Calgary, N. W. T., the following buildings: An engine house to hold twelve locomotives, machine shop, car shop, blacksmith shop, stores building, coal pockets, ash pits and turntable. All the buildings will be of Calgary sandstone. The machine shop and car shop will be 200 feet by 66 feet, the blacksmith shop 60x66 feet, and stores building 24x30 feet.

The Grand Trunk Railway Company has recently added to its new equipment four baggage cars, 60 feet in length, and a large number of new refrigerator cars on the well-known Wicke's patents for refrigerator cars. The cars are about thirty-five feet long, and thirteen feet high, with a carrying capacity of 60,000 lbs. each. They are also equipped with automatic draw-bars, and Westinghouse air brakes, and designed to run at a high rate of speed. The Wells and French Car Company, of Chicago, have just commenced the delivery to the Grand Trunk Railway of 500 new thirty-ton box cars, of the standard Grand Trunk design and finish.

The Kootenay Railway & Navigation Company is being floated in England, and has been formed to consolidate and extend the railway and steamboat service in British Columbia controlled by J. J. Hill. This company will acquire the Kaslo & Slocan railway and the steamers of the International Navigation & Trading Company, which at present run between Kaslo and Nelson and connect with the Spokane Falls & Northern Railway. A new line is to be built 53 miles long from the southern end of Kootenay Lake to meet the Great Northern at Bonner's Ferry, and the Northern Pacific at Sandpoint, and in future, it is said, the line of steamers will run from Kaslo to the southern end of Kootenay lake instead of to Nelson.

There have been some doubts as to whether the deepening of the St. Lawrence canals to 14 feet can be completed by the opening of navigation next year. In the mind of the canal experts here those doubts have now been set at rest. Collingwood Schreiber, the chief engineer of canals, returned recently from an inspection of the works, in company with Walter Shanly, C. E. The latter has been very skeptical up to date as to the early completion of the work. However, both these gentlemen state that they are satisfied that, if the present rate of progress is maintained during all the available time in the interim, the canals will be completed to a uniform depth of 14 feet by the opening of navigation next season. The only possibility of failure arises from the fact that the contractors may relax their energy.

The convention of railroad trackmen have elected the following officers: James Logan, Ottawa, president; J. Hogan, Ottawa, first vice-president; J. W. Trickey, Sudbury, second vice-president; H. F. McKinney, Hintonburg, recording secretary; J. Hogan, Ottawa, treasurer; W. Powell, Moncton, chaplain; A. Hawkins, Fletcher, guide; C. Noyes, Peterboro, sentinel.

The Grand Trunk Railway is said to have secured a contract for the transportation of a hundred thousand tons of steel plates from the Illinois Steel Company, Chicago. These plates are to be shipped to Belfast, Ireland, and are being brought to Midland, Ont., handed over to the Grand Trunk, and shipped to Montreal for export to Belfast.

Marine News.

H. McLennan, J. Crathern, G. Hyde, A. Kingman, H. E. Murray, Montreal, and A. Buntin, Toronto, have been incorporated as a steamship company doing business as the Beaver line; capital, $250,000.

J. T. Hamilton, H. M. Hart, G. Musgrave, C. W. Outhit, R. T. Braine, T. Dixon, W. J. Butler, F. J. Phelan, L. Hart, W. N. Wickwire, J. A. Johnson, Halifax, N. S., have been incorporated as the Briardene Steamship Company, Ltd.; capital $60,000.

The special committee appointed by the Toronto City Council to report on the best means of providing communication between the city and the Island other than the present ferry service has decided on a chain ferry at the Queen's Wharf to cost $8,000.

At a meeting of the board of directors of the Richelieu & Ontario Navigation Co., held in Montreal, Sept. 7th, contracts for new boilers for several vessels of the fleet were awarded, and it was decided to build three additional steamers for next summer's business, two for the Montreal and Quebec route, to be built in Montreal, and a third boat for the western trade.

The last link between the Crow's Nest Pass Railway and Nelson, B. C., will be completed when the C. P. R. places upon the Kootenay lakes service a vessel specially adapted for the traffic. It will be of the enlarged tug type and very powerful. The length is 128 feet, 25 foot beam, and it is designed to draw 10¾ feet of water. The engines are compound jet condensing, and the cylinders 18 and 32 inches, with a 22-inch stroke. The reason for the exceptional power is that the new craft is to haul the car barges which will ply between Kushonook on the completion of the C. N. P. R. to that point and river points with terminal connections.

M. R. Davis, Kingston, Ont., will superintend the building of a new boat for Capt. D. Noonan. It will be a twin screw steamer, costing about $20,000, having thirty staterooms, and designed to carry about 300 passengers. It will be built at Westport, Ont., and is intended for service on the Rideau canal.

Midland, Ont., is doing a vastly improved business this season and is rapidly coming to the front as a lake port. The depth of water in the harbor admits vessels of deeper draught than can enter most lake ports, and early in the season the Superior City arrived at Midland from Chicago with a cargo of 266,550 bushels of corn. This enormous cargo was delivered in Montreal in 48 hours.

Work will soon be over for the season on the survey which is in progress for a canal line from Hungry Bay, on the St. Lawrence, to Lake Champlain. The United States Congress authorized a commission to report on the practicability of improved waterways between the Western States and the seaboard, which, after making a preliminary report, was authorized to go to the expense of surveys of every practicable route sufficiently full to base estimates of cost upon. This summer surveys have been in progress for a canal on the United States side between Lakes Erie and Ontario and between Lake Ontario and the Hudson river, and between Lake St. Francis and Lake Champlain.

The Government dredge Cape Breton is at work in the harbor of St. John, N. B. The construction of the deep water terminus for the I. C. R. is being pushed.

The Grand Trunk Railway Co. has a contract with the Leyland Line for a tri-weekly steamship service during the coming winter between Portland and Liverpool. Five of this company's vessels, which are now plying between Liverpool and New York, will be transferred to the Portland route. These vessels will replace the ships of the Dominion Line, which, last year gave the service between Liverpool and Portland. The new arrangements will come in force only next year, and, in the meantime, the Allan and Leyland lines will work together on that service. It is also reported that the Leyland line next summer will make an effort to retain the Canadian business secured during the winter months by running into Montreal instead of New York.

Personal.

W. A. Clement, C. E., the Toronto city roadway engineer, is very seriously ill with typhoid fever.

Wm. Reid was accidentally killed by the fly wheel at the Metropolitan Rolling Mills, Montreal, last month.

F. R. F. Brown has opened an office at 22 Street Railway Chambers, Montreal, as a consulting mechanical engineer.

R. Barrow, son of the Hamilton, Ont., city engineer, has entered the engineering course at the School of Practical Science, Toronto.

James McKenna, a delegate to the firemen's convention in Toronto, was killed at Morrisburg, Sept. 10th, while attempting to board a moving train.

S. Aikens, fireman, was on Sept. 14th instantly killed by the explosion of a boiler in Frank Entrichen's brickyard on the 5th line of Zorra, Oxford county, Ontario.

James McArthur, land surveyor, Aylmer, Que., who was nearly boiled to death while taking a bath at Eastman's Springs, died a few days later. He was 78 years old.

N. Bruchesi, an engine driver on the Grand Trunk Railway, died suddenly in Montreal a short time ago. Mr. Bruchesi was the driver on the first engine that passed over the Canada Atlantic Railway.

Thos. Graham, proprietor of the Banner File works, Almonte, Ont., died at his home there. He was born in Ecclesfield, England, in 1834, and was twice married, being the father of twenty-one children. Mr. Graham was at one time at the head of a very large hand cutting file works in Toronto.

Dr. John Hopkinson, an English electrical engineer, and his son and two daughters have been killed, while ascending the Dents de Vaulion, in the Canton of Vallais, Switzerland. A summary of Dr. Hopkinson's report on the transmission of electric power from Niagara to Toronto was published in The Canadian Engineer some months ago.

C. H. Sutherland, a well-known draughtsman in the motive power department of the Grand Trunk Railway, died suddenly at his residence, Montreal, recently. He had not been in the best of health for some days, but no serious results were anticipated. Heart disease is supposed to have been the cause of death.

W. C. Clark, an engineer in the employ of the C. P. R., was found dead on the floor of his room at the village of Cedars, near Montreal, last month. He was partially dressed, and is supposed to have died while preparing for bed. He was 27 years of age. An inquest was held and a verdict returned of death from indigestion and cerebral congestion.

James Brown, C. E., died in Amherst, N. S., a short time ago, aged 57 years. Deceased was born in Aberdeen, Scotland, and came to this country in 1876. He was a practical engineer of great ability, and besides being for a term manager of the Londonderry mines, held responsible positions on the Intercolonial and Canadian Pacific railways, at Joggins Mines, Springhill, and Glace Bay. Mrs. Brown, who was Miss Sybella Gilbert, sister of Lord Belhaven, and one daughter, May, survive him.

Ed. Cooper, late manager and part proprietor of the Cooper Machine Co., Toronto, manufacturers of the Imperial Gas Engine, has taken a position as traveling representative of the Goldie & McCulloch Co., Galt, Ont.

While attempting to stop the fly wheel of a wood sawing machine, with a piece of wood, Peter Grice, Victoria, B. C., was instantly killed, death being caused by the fly wheel breaking, pieces of which penetrated the body, tearing out the heart and liver, both of which were afterwards picked up by the police.

The department of mathematics in McGill University will be strengthened by H. M. Tory's transference from the Physics Department, in which he has hitherto done part of his work; and he will be more at liberty, in the future, to undertake lecture and tutorial work in the first years of the mathematical curriculum. Mr. Tory's work in the physical laboratory will be taken over by R. O. King.

At the annual general meeting of the Great Northwestern Telegraph Company, Toronto, the following officers were elected: H. P. Dwight, president and general manager; Adam Brown, of Hamilton, vice-president; H. N. Baird, James Hedley A. S. Irving, W. C. Matthews, of Toronto, Richard Fuller, of Hamilton, Hon. William McDougall, C. B., of Ottawa, and Charles A. Tinker, of New York, directors; George D. Perry was reappointed secretary and auditor, and Arthur Cox, treasurer. The statement of the year's business showed a considerable improvement over the previous year, and the opinion was expressed that with the new connections and extensions of the company they might reasonably look for a still further improvement during the coming year.

Thomas Fuller, late chief architect of the Department of Public Works, died at his residence in Ottawa, Sept. 28th, aged 76. Mr. Fuller was born in Bath, Eng., and came to Canada in 1857. In 1859 in competition for parliament and departmental buildings, Ottawa, his design for the parliament building was adopted, and he was awarded second prize for his designs for departmental buildings, which included a residence for the Governor-General. Mr. Fuller superintended the erection of the parliament buildings. In 1867 he was the successful competitor for a design for the new capitol building for the State of New York at Albany, and removed to that city, where he superintended the erection of the building. In 1831 he returned to Canada, and was appointed chief architect of the Public Works Department, a position he held until about a year ago, when he was superannuated, but retained an advisory position in the department. His health has been failing for some time. Mr. Fuller was well-known throughout the whole of Canada, and has designed the greater number of all the public buildings erected in the last fifteen years.

Dr. James Wallace Walker, the new professor of organic chemistry at McGill University, was educated at the University of St. Andrews, Scotland, and graduated there as Master of Arts in 1889. After a short time spent in teaching mathematics at the Madras College, St. Andrews, he was appointed lecture assistant in chemistry at the university and afterwards engaged in original research in organic chemistry. In 1892 he entered the University of Leipsic, and was shortly afterwards elected to an 1851 Exhibition Scholarship. In Leipsic he studied chemistry in the laboratories of Professors Wislicenus and Ostwald and was awarded in 1896 the degree of Ph.D., with highest honors. On returning to England Dr. Walker worked for a short time in the laboratory of Professor Armstrong at the Central Technical College, in London, but soon afterwards, in 1896, was appointed lecturer in organic chemistry under Professor Ramsay, in University College, London, and was last year also appointed examiner in chemistry for the Arts, Science and Medical degrees at the University of St. Andrews. Dr. Walker has published the results of his researches in a number of papers. He is a clear and lucid lecturer and he has proved himself to be an attractive teacher, both with elementary and advanced students.

The Board of Governors of McGill University has appointed Professor R. B. Owens, E.E., of the University of the State of Nebraska, to the W. C. McDonald chair of electric engineering at McGill University, lately held by Professor Carus Wilson. Professor Owens is a native of Maryland, and was educated at Johns Hopkins University, Baltimore, gaining a high standing in mathematics and physics. Proceeding from Johns Hopkins University to Columbia University, he

there obtained in 1891 the post-graduate degree of E.E. In the intervals of his college course the young student acquired a fund of practical knowledge with several well-known electrical companies. Shortly after receiving his degree Mr. Owens was appointed assistant professor of electrical engineering in the University of Nebraska, and in 1894 he was made professor. In the meantime he served as one of the judges of electrical exhibits at the World's Fair. Professor Owens has recently been elected to a Tyndall fellowship by Columbia University, and was director of the Bureaus of Electricity and Machinery at the Trans-Mississippi Exposition at Omaha. He is a member of the Western Society of Engineers, the American Society of Mechanical Engineers, and the Council of the Society for the Promotion of Engineering Education, and vice-president of the American Institute of electrical engineers. He has contributed important articles to engineering societies and to the electrical press on the subject of Electricity and of Technical Education.

Prof. Ernest Rutherford, who has been appointed to the W. C. McDonald chair of physics in McGill University, recently vacated by Prof. Callendar, was a student at Canterbury College, Christchurch, New Zealand, for five years, obtaining the degree of B.A. in the University of New Zealand, in 1892; the degree of M. A. by examination in 1893, with double first-class honors in mathematics and physical science; and the degree of B.Sc. in 1894. During 1894 and 1895 he was engaged in research work, and in the latter year was awarded an 1851 Exhibition Science Scholarship to enable him to continue his researches in England. Proceeding to Cambridge, he has carried on investigations in experimental physics in the Cavendish Laboratory for the past three years under the direction of Prof. J. J. Thomson, and in June, 1897, was awarded the degree of B.A., and in the following December the Coutts-Trotter Studentship, in recognition of his researches. Prof. Rutherford's experience in teaching has been gained in New Zealand and by acting as demonstrator of physics in the Cavendish Laboratory. In addition to a research upon Uranium and Thorium Radiation, which has occupied his attention during the past year, Prof. Rutherford has completed several important researches. Among them may be mentioned: An investigation on the use of a magnetic detector for the investigation of electrical waves; with this detector he was able to send signals by means of electric waves, and without wires, across about ¾ of a mile of the mostly densely-populated part of Cambridge. This was done nearly three years ago, and before the recent attempts at wireless telegraphy. A series of papers in The Philosophical Magazine, on the electric properties of gases under the influence of Roentgen rays, Uranium rays, and ultra-violet light. These papers are characterized by Prof. Thomson as being distinguished by the importance of the results obtained by the ingenuity displayed in the design of the apparatus, and by the grasp of the physical principles shown in the interpretation of the results. Prof. Rutherford's work is well known on the Continent of Europe as well as in England.

LITERARY NOTES.

The October number of The Canadian Magazine maintains the standard of that publication. The brilliantly and artistically colored cover announces seven short stories and seven leading articles. These are duly found within, together with a couple of poems by Canadian writers.

The C. W. Hunt Company, West New Brighton, N. Y., has just issued three new catalogues from the press. They are: No. 9,805—"Industrial" Railways; No. 9,807—Mast and Gaff Fittings, Coal Tubs, Hoisting Blocks, Wheelbarrows; No. 9,811—Manila Rope for Hoisting and Power Transmission.

The Canadian General Electric Co. has just issued a catalogue, which is neat and attractive in a high degree. The different departments are fully taken up and the various apparatus fully described. Among other interesting features of this catalogue is the department devoted to electric heating. There are innumerable appliances which are for the comfort of mankind, from flat irons to chafing dishes, and are fully described and illustrated.

The Street Railway Journal for September, 1898, is largely devoted to matters of interest to the delegates to the fifteenth annual convention of the American Street Railway Association, held in Boston, September 6th to 9th. The street railways of Boston are fully described. From cover to cover the issue is a triumph of journalism. From a business standpoint the 284 pages of advertisements are sufficient tribute to the skill and success of the management, while the 119 pages of reading matter are contributed by the most able writers and are magnificently illustrated. The full report of the proceedings of the convention is found in the October number of the Journal.

Hand-book of Corliss Steam Engines, by F. W. Shillitto, jr., is a very interesting and instructive work of over two hundred pages, which describes in a comprehensive manner the erection of engines, the adjustment of the Corliss valve gear, and the care and management of Corliss steam engines. Under the head of erecting the following subjects each receive discussion in a separate chapter: Preparing foundations, reference lines for locating, templates, foundations, placing main parts in position, lining and leveling, assembling the moving parts. Under the head adjusting Corliss valves the following chapters are found: The valves, valve gears, squaring the valves, dash pot rods, eccentric rod, rocker arm and reach rod, centring the engine, setting the eccentric, adjusting the governor, indicator diagrams, a few pointers on double ported valve and long range cut-off, tables and memoranda, etc., as well as seven chapters describing different varieties of the Corliss engine.

THE DISPOSAL OF SEWAGE IN EUROPE.

At the meeting of the American Public Health Association recently held in Ottawa, Thomas Macfarlane, chief analyst, Inland Revenue Department, read a paper entitled, Remarks on the Systems of Refuse Disposal in Various European Cities. The cities in question were London, Birmingham, Manchester, Oldham, Rochdale, Glasgow, Hawick, Berlin, Leipsic, Freiberg, Bremen and Braunschweig, all of which the author visited in the summer of 1896. The essential features were described of the ten different systems of disposal in use in these cities, and their disadvantages and merits were commented on from the point of view of the agricultural chemist. Nearly all of these systems leave a great deal to be desired, and Mr. Macfarlane tries to indicate the direction in which he thinks improvement would be possible. In large cities where access to the sea is impossible, and where the water carriage system for excreta has been adopted, it is suggested that storm and surface water should be excluded from the sewage, thorough comminution effected of the solids in the latter, and utilization of the fertilizing constituents on sewage farms of sufficient extent. For other cities, towns and villages the author recommends the introduction of the Mop-Litter system as practiced in Bremen, and other German towns. As examples in Canada of these two methods of treatment it is pointed out that the first is in use at the asylum for the insane in London, Ont., and the second at Grand Hotel, Caledonia Springs.

EUROPEAN METHODS OF TESTING SEWER PIPES OF CEMENT AND CLAY.

The International Association for the Testing of Materials, in 1896, appointed a committee to investigate the methods of testing sewer-pipes of cement and clay, as up to that time there had been no uniform method of testing, and practice varied widely. Mr. Gary, chief of the section for the tests of materials, at the test laboratory at Charlottenburg, was directed to take charge of this investigation, and his preliminary report is published in "Les Materiaux de Construction," Nos. 23, 24, the official organ of the association. Mr. Gary, in 1895, had already investigated, for the German Association of Manufacturers of Portland Cement, the methods employed by governments, municipalities and individuals in testing the strength of cement pipes. He found that these tests varied in each case, and none were regarded as complete for the purpose intended. Similar conditions existed in other countries than Germany.

In the investigation to be made Mr. Gary concluded that the points to be determined were as follows: The resistance to internal and external pressure; impermeability; resistance to the attack of acids; and the wear upon the interior by sand passing with the water. The tests should then mainly determine the bursting and crushing strength, and the texture and

composition of the paste used. The resistance to exterior pressure is the most important property in a cement or clay pipe; for, with a few exceptions, such pipes are simply covered with earth or sand, and are not placed in masonry. The pressure upon them will differ as these pipes are laid under traveled streets, under railway embankments, or under the foundation walls of buildings; and it is necessary, in passing judgment upon the fitness of these pipes, to distinguish between the loads to which they are to be subjected in use. Mr. Gary then details the practice of a number of German cities in the test of cement pipe, as follows: The Department of Public Works of Liegnitz requires that a cement pipe one meter (3.28 feet) diameter should resist the pressure of a layer of earth 3 meters (9.84 feet) thick; at Rosenheim, pipes covered with 12 to 16 inches of earth should resist the pressure of a heavy vehicle; and at Colmar, when there is any doubt of the solidity of a pipe, a loaded wagon is passed over the laid pipe. At Schwerin, in Mecklenburg, cement pipes must resist, without cracking, a pressure equal to 50 kilograms per linear meter and per centimeter of diameter. This test is made by placing railway rails on the top of the uncovered pipe. The city of Freysing prescribes that the pipe should support a "load of 6,000 kilos, concentrated upon the top of the pipe;" and Passau demands that the pipe resist a pressure of 805 lbs. per lineal foot. At Zeitz where the pipes are buried 6 to 8 feet beneath the surface, a steam road roller is passed over them before acceptance. Clay pipes, 1 meter diameter, have been tested at Mannheim, by burying them in the earth, with a covering layer about 18 inches thick. Over the pipe was then placed a double plank platform, about 3 inches thick in all, and 3.28 feet square, and on this was placed the test load. The rupturing load was found to be about 28,600 lbs.

For the test pipes of "armed-cement," or cement reinforced by a double iron mesh on the Zisseler system, the engineer of bridges, at Breme, prescribes the following test: The pipe is buried in sand in a solid wooden box; then by means of a cover fitting inside the box a pressure of 7,500 kilos. per running meter, or about 500 lbs. per lineal foot, is applied to the pipe. The pipe is required to stand this pressure without deformation or cracking. For pipes of oval section, 120x96 cm., and sides 6.5 cm. thick, armed with three layers of metallic mesh, a uniform load of 9,000 kilos. per meter, or a little over 600 lbs. per foot, is prescribed. At the Hague the resistance of beton pipes is determined by placing them in a trench and then loading them uniformly on the square meter of horizontal projection. One pipe in each 50 is submitted to this test; and this load is carried up to 12,000 kilos. for pipes 1.5x1 m. and 1.2x0.8 m. At Copenhagen, Emanuel Jensen employs a process for testing pipes of clay and of "armed cement" which has given very satisfactory results. A heavy timber is embedded in the soil, carrying upon one end a heavy counterweight of cement, and near this are two bars of iron, pierced with holes, attached to the sides of the timber. The pipe to be tested is placed in a strong wooden box, nearly filled with sand, and resting upon the timber, and pressure is applied to it by a lever and saddle with the lever support on a pin passing through the holes in the iron bars. The advantage of this process is that the commencement of cracking in the pipe can be noted; though this is of little advantage in the test of clay pipes, as after the appearance of the first crack the pipe will support but little more. But in the case of the Monier and Zisseler construction, where the iron skeleton augments the cohesion of the material, the appearance of the first fissure precedes by some time the final crushing load.

At the test laboratory at Malines, the resistance of pipes to exterior pressure is tested by a Kirkaldy machine; the pipe being placed between two wooden saddles which each embrace one-third of the circumference of the pipe. But as it is difficult to insure contact with all the inequalities of the pipe, the process is not satisfactory. From the report of Mr. Gary it seems. The Engineering News concludes, that about the only sewer pipe tests so far employed relate to the resistance against exterior pressure; and he well remarks that a uniform, systematic and reasonable test of sewer pipe, of various materials, has yet to be devised; or at least, to be introduced, into general practice.

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FIRES OF THE MONTH.

Sept. 6th. The new mill of the estate Masson at Terrebonne, Que., was destroyed, together with a grist mill, and the Terrebonne Electric Light Co.'s plant; loss, estate Masson, $10,000; fully insured; Electric Light Co., $1,500; insurance, $700.——Sept. 13th. D. A. Ghent's carriage factory, Burlington, Ont.; loss, $8,000.——Sept. 15th. The Belleville, Ont., Gas Works were damaged to the extent of $500.——Sept. 16th. The Montreal Street Railway Co.'s car sheds; damages, $200,000; fully insured. ——Sept. 18th. W. G. Harris' mill stock and metal premises, Toronto, were burned down; loss, $8,000.

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THE TORONTO MAGNETIC OBSERVATORY.

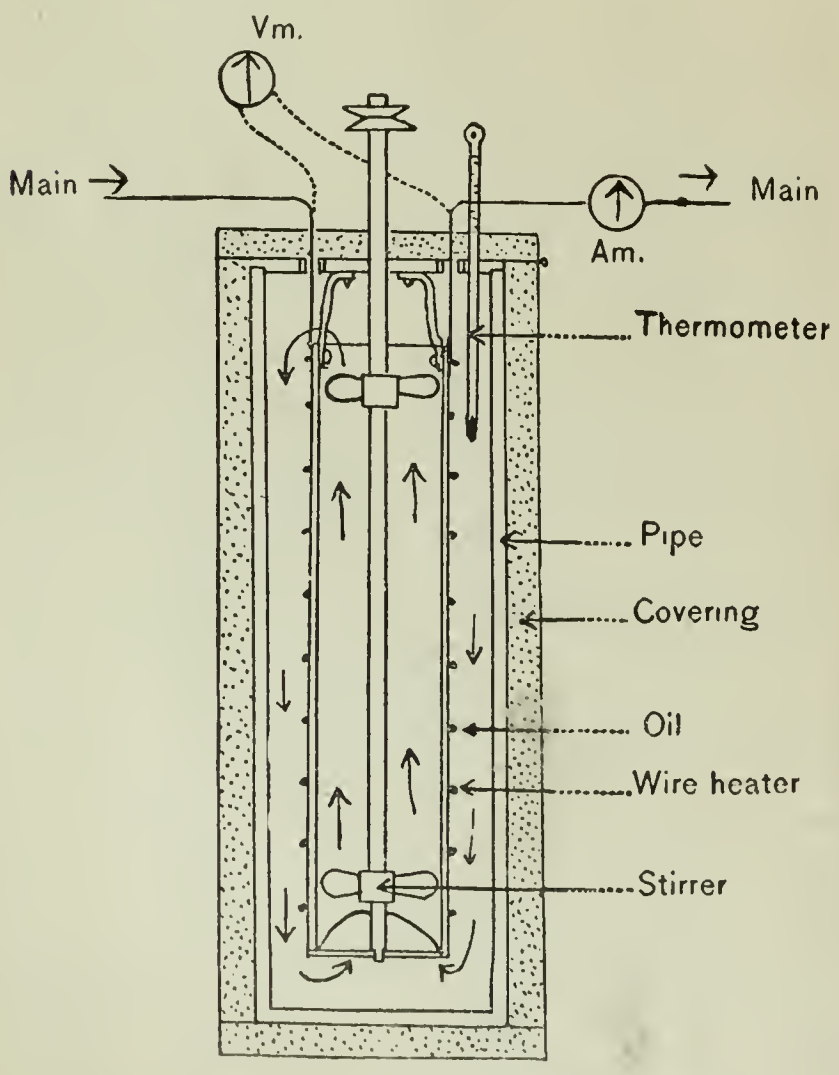
In the February number of THE CANADIAN ENGINEER was given a brief history of the Toronto Magnetic Observatory and of the troubles that have resulted from the erection of buildings in an all too close proximity to the Observatory, later by various city electrical installations and still more recently by the Toronto electric railway system. In an interview with the Honorable the Minister of Marine and Fisheries in February, 1897, the director of the Observatory suggested that before deciding finally on a removal of the magnetic instruments to another site and breaking one of the longest series of magnetic records outside of Europe, it would be well to invite an expression of opinion from one of the most celebrated magneticians of Europe, several of whom were to be present at the meeting of the British Association for the Advancement of Science in the following August. The Minister was pleased to approve of the suggestion and on the arrival of members of the association the director wrote to the various members of the Kew Committee of the Royal Society who were in Toronto, and also to Dr. Van Ryckevorsel, of Holland, and Professor F. H. Bigelow, of Washington, U.S., requesting the favor of their presence at the Observatory to inspect the photographic magnetic curves there obtained with the view of expressing an opinion as to the advisability of continuing the records at the present site or of removal to some point distant from electric tramways. Prof. Rucker, F.R.S., Prof. Carey Foster, F.R.S., Prof. Fitzgerald, F.R.S., Dr. Van Ryckevorsel and Prof. Frank Bigelow are the gentlemen who courteously accepted the invitation and were pleased to sign a statement that in their opinion the value of the magnetic observations at Toronto had been seriously impaired by the trolley system and advising removal to some other site. Later on, Professor Rucker, speaking at the Massey Hall, stated that Toronto's magnificent electric tramway system had ruined the Observatory. As it was feared that the public on hearing such an expression from the learned members of the association and not recognizing the difference between the Toronto Magnetic Observatory and the central office of the Dominion Meteorological Service, might imagine that a site suitable for the one would be unsuitable for the other, Professor Rucker wrote a letter to the effect that the statements made regarding the Toronto Observatory had reference to the magnetic observations only and had none whatever to the meteorological work there performed. It became evident then that the opinion held by gentlemen engaged in corresponding scientific work abroad, was quite in accord with that of the Director of the Observatory, and shortly after the close of the meeting of the B.A.A.S. he was authorized by the Government to choose and purchase a suitable site for a new magnetic observatory, and after making careful examination as to the distance that the electric currents might effect the magnets, it was decided to erect the new building near the village of Agincourt, a point about 10 miles distant from the present Observatory, easily accessible by railway, and yet very unlikely to be invaded by the trolley system.

The new Observatory, which was commenced in June and finished during the early days of September, consists of two parts, first, a circular stone cellar 19 feet in diameter, the walls two feet in thickness, the floor concrete and the roof covered with felt and gravel, in which, on stone piers sunk in concrete to a depth of six feet below the floor, are placed the self-recording photographic instruments, namely, the declinometer for recording changes in the direction of the magnetic needle, and the bifilar and vertical force instruments for registering respectively changes in the horizontal and vertical components on the earth's magnetism. Above ground and connected with the cellar by a flight of steps is an erection which is divided into two portions, in the larger of which absolute magnetic determinations will be made, piers being provided on which to place the necessary instruments, and an adjustable opening on the roof for transit work, and the smaller an office which will be heated by a copper stove. Observations were first made in the new building on September 16th, and it was hoped that by October 1st all the instruments will have been adjusted in their new position and everything running smoothly. Results already obtained have shown that values will differ but slightly from those obtained at the old Observatory, and it is proposed to make a very careful comparison before dismounting the old eye reading instruments in Toronto. Very great care has been taken in selecting material for the building, every stone used was tested for magnetic effect and none but copper or zinc nails and fastenings have been used. There appears to be every prospect that the new Observa-

tory will be admirably suited for the purpose for which it has been designed, and there is strong reason to think that the series of observations at Agincourt will be practically a continuation of the old and valuable series of observations in Toronto. All the photographic records will be sent for development to the central office of the Dominion Meteorological Service.

THE PROTECTION OF STEAM HEATED SURFACES.

An interesting investigation has recently been carried on at the request of Edward Atkinson, having for its first object the discovery of the relative efficiency of several kinds of steam-pipe covering, and second to ascertain the fire risk attained upon this and certain methods and materials for insulation of steam-pipes. An attempt was made to show the gain in economy attendant on the increase and thickness of covering, and to show the exact financial returns which may be expected from the given outlay for covering steam pipes. Charles L. Norton made the experiments during a large part of the years 1896 and 1897, and considerable information is given in the report of these investigations on many minor matters and conditions affecting the transfer of heat from the steam pipe to the surrounding air. In reproducing some of the conclusions reached, as a result of Mr. Norton's experiments, we omit results of the tests of insulating materials, as they are not of great interest to Canadian steam users, but the report of the methods employed, as described in the Technology Quarterly, is given in full.



PLAN OF APPARATUS FOR TESTING STEAM PIPE COVERINGS.

The method adopted is one which, so far as is known, is original. A piece of steam pipe is heated from the inside by electricity. The amount of electrical energy supplied is measured, and hence the amount of heat furnished is known. If the steam pipe is kept at a constant temperature by a given amount of heat, it is because that amount is just equal to the heat it is losing, for if the supply were not equal to the loss, the temperature would rise or fall. In other words, the heat put into the pipe is just equal to the heat lost from it by radiation, convection and conjunction. By measuring the electrical energy supplied, the heat put in can be determined, and hence also the heat taken out or lost. It must be borne in mind that a given amount of electrical energy always produces the same definite amount of heat, the amount of heat furnished by one electrical unit of energy being known with greater accuracy than the amount of heat given out by a pound of steam in condensing.

The apparatus for making tests by this method comprises several pieces of steam pipe of different diameters and lengths, heated electrically within by means of coils of wire in oil. The oil is stirred vigorously and serves as a very efficient carrier to heat from the wires to the pipes. A brief description of the smallest tester may make the details of the apparatus more easily understood. A section is shown in the figure.

A piece of 4-inch steam pipe, 18 inches long, is closed at one end by a plate welding in, and at the other end by a tightly fitting cover. This pipe is then filled with cylinder oil, and a coil of wire of sufficient carrying capacity, and a stirrer are introduced into the coil. A thermometer is inserted in such a position as to record the temperature of the oil. An ammeter and voltmeter or a wattmeter may then be connected so as to record the amount of electrical energy supplied. The stirring must be brisk, and if enough power is put into the stirrer, to be comparable with the electrical energy supplied, such amount must of course be added, as it also is converted into heat. The apparatus is suspended in the middle of the room on non-conducting cords, and the thermometer read with a telescope, so that no heat from the person of the observer may be added to the supply given to the cover from within, and also that care may be taken not to produce air currents by walking near the apparatus during a test.

In making a test the following operations are carried out, and observations are taken in the following order:

The current is turned on, and heat is generated in the wire coil until the wire, oil and steam pipe have reached the desired temperature at which it is proposed to test. The current is then gradually diminished, until it is found to be of just the amount necessary to keep the pipe at this temperature without a rise or fall of one-tenth of a degree in 30 minutes. A reading of the voltage and current is now taken at intervals of 30 seconds, and the Watts and B.T.U. are computed from their average. We then have the number of B.T.U. lost from the outside of this particular pipe at this particular temperature. If, now, there is placed a steam-pipe cover around the pipe, it is found that a less amount of energy is sufficient to keep it at the required temperature, the difference being the amount of heat saved by the covering. The minimum length of time considered sufficient for equalization of heat, or "soaking in," to the cover, is 6 hours. If, after a second heating of 6 hours, no change in the conducting power is noted, the cover is considered in a permanent condition, and is tested. Some covers, notably those composed wholly or in part of wool, cannot be considered dry and constant until after an exposure upon a pipe at 200 pounds pressure for 6 or 8 days. Covers containing sulphite of lime are also slow in drying.

The three thermometers used were frequently standardized in naphthaline, and were examined to note any

disagreement among themselves. All tests were made at a temperature corresponding to 200 pounds steam pressure.

A comparative test was made in 1895, upon a number of steam-pipe covers on a 4-inch tester, 16 inches long. The results obtained have been published in the circulars issued by the Boston Manufacturers' Mutual Fire Insurance Company, and by the Steam Users' Association. The values given were stated to be purely relative, the specimen being too small to give reliable data on the absolute conduction, and the surrounding conditions not being controlled other than to maintain them constant during the several runs. The ends of the specimen were covered by massive heads, and the whole tester was situated within a few inches of brick wall and a stone pier. It was said that the heat loss was probably high, and while the exposure may have been such as to make it so, being a rather harsh test, yet one which was rigidly uniform in its requirements of the several covers. In short, the actual loss of heat per square foot of the pipe surface was correct for that particular piece, under the conditions of the test, but was not sufficient for the estimation of the actual saving which might be expected from the general use of coverings. It was deemed wise, therefore, to construct new heaters, 4 and 10 inches in diameter, and 36 inches long. These were suspended by non-conducting cords in the centre of the laboratory, so as to hang freely and not be in contact with any conducting supports. Conduction up to the lead wires and stirring rod was found to be negligible.

This seems to have approached more nearly the conditions of actual practice than can be obtained by any other method of testing, except the actual use of a long run of pipe, and the determination of the amount of heat put into such a pipe by the "condensation" method, offers many difficulties, and is open to much uncertainty. Therefore, in adopting this method, a reasonable exposure of the pipe is used, and there is an exceptionally good opportunity to measure the heat supplied.

THE INFLUENCE OF PAVEMENTS ON PUBLIC HEALTH.*

BY A. W. CAMPBELL, C.E., PROVINCIAL ROAD COMMISSIONER FOR ONTARIO.

In presenting to this association a paper on the sanitary aspect of pavements, I have been actuated by a desire to obtain information, rather than to impart it. Ontario has so recently developed from a wilderness into the home of civilization and culture; our villages have grown so quickly into towns, our towns into cities, and the advance of the various sciences has been so rapid, that our people scarcely realize the changed circumstances and the need of carefully directing their energies in meeting the demands of the times. In my visits to different parts of the province I am constantly met with evidences of the good wrought by this association. I find that in very small villages even inefficient drainage, cess-pools, piggeries, slaughter-houses, and impure water supplies are not now tolerated as they were once, and that this is due to the work of your association. It is with considerable hope, therefore, that I have undertaken to briefly lay before you the subject of pavements and public health, confident that you will lend your assistance in aiding our knowledge of this as of other matters pertaining to perfect sanitation; and that where reform is needed your aid will be afforded.

*A paper read before the Association of Medical Health Officers of Ontario.

There is no one paving material which possesses every quality desired in a pavement to meet all conditions and uses. The ideal pavement remains to be discovered; but the features which should belong to such an ideal pavement are so numerous and of such varying character as to render the search apparently a hopeless one. The ideal pavement: 1, should be cheap and economical of maintenance; 2, should be durable; 3, should suit all classes of traffic; 4, should offer little resistance to traction; 5, should give a good foot-hold to horses; 6, should be adapted to all grades; 7, should have a good appearance; 8, should not be muddy nor pervious to water; 9, should be sanitary, that is, non-absorbent, not subject to decay, easily cleaned, not dusty, not noisy.

It is apparent then that, notwithstanding the importance of the sanitary aspect of a pavement, there are other features which must be considered. The primary intention of a pavement is to accommodate travel, and to provide one which will do this satisfactorily, which will be durable, cheap, of good appearance, healthful, and possess in the highest degree the other qualities enumerated, in view of the location, nature and extent of traffic, is the problem which presents itself to the paving engineer. Just as no absolutely perfect paving for every time and place has been discovered, it is doubtful if any paving material now used should be utterly condemned. Each has its place in which, until the ideal universal pavement is found, it will be more satisfactory than any other which could be used under that particular set of circumstances of soil, climate, traffic, etc. The purpose of this paper, however, is to treat of the healthfulness of paving in general, of the sanitary aspect of commonly used paving materials; that is, asphalt, stone blocks, vitrified brick, cedar block, and broken stone (macadam), with respect to absorption, decay, ease of cleaning, dustiness and noise.

Of all these, cedar block has received the greatest censure on the score of unhealthiness. Dr. O. W. Wright, a health officer of Detroit, is quoted as saying: "On sanitary grounds I must earnestly protest against the use of wooden block pavements. Such blocks, laid endwise, not only absorb water which dissolves out the albuminoid matter that acts as a putrefactive leaven, but also absorbs an infusion of horse-manure and a great quantity of horse-urine dropped on the street. The lower end of the blocks, resting on boards, clay or sand, soon becomes covered with a fungoid growth thoroughly saturated with albuminous extract and the excreta of animals in a liquid, putrescible form. These wooden pavements undergo a decomposition in the warm season, and add to the unwholesomeness of the city. The street, in fact, might as well be covered a foot deep with rotting barnyard manure so far as unwholesomeness is concerned. Moreover, the interstices between the blocks and the perforations of decay allow the foul liquids of the surface to flow through, supersaturating the earth beneath, and constantly adding to the putrefying mass." Cedar block has been condemned in similar terms by many others. On the other hand, Col. Heywood, Engineer of the city of London, England, has said: "It has been said that wood pavements at all times smell offensively and may be unhealthy; but although some city streets have been paved with wood for thirty years, no complaints that I am aware of have been made to the commission on this head, and the inhabitants at all times have not only expressed great anxiety lest the wood should be replaced by other materials, but have subscribed towards the cost of its renewal. . . . I have at times noticed offensive emanations from it near cab-stands, but am unable to find further evidence of its unhea thiness. These remarks must be

held to apply only to public streets open to the sun and air, and traffic ; in confined places and under some conditions, wood might be objectionable. I have seen it decaying in confined places without traffic."

The one statement by the Medical Health Officer of Detroit refers directly to the cedar-block pavement as we understand it in this country. The other opinion, that of Col. Heywood of London, is expressed regarding the wooden pavement as laid in European countries. Between these two pavements there is a vast difference. Under European practice, many of the pavements are of the Karri and Jarrah woods of Australia which are thoroughly saturated with resins, are very hard and are not subject to decay. They are sawn into brick like blocks and laid on concrete. Where soft woods are used, they are also cut into regular oblong blocks and laid on concrete; and are saturated with creosote or treated with some other preservative process. Wooden pavements of America, however, represented by cedar-block, are of a very different order. The round blocks, of irregular diameter, are merely the untreated wood, still carrying the bark. These, placed on a bed of sand, are under the most favorable conditions possible for decay, being constantly exposed to moisture, air and warmth. With no preservative treatment they are enabled to absorb to the fullest extent all forms of liquid street filth which, in the process of putrefaction, feeds on the organic matter of the wood. The surface, which quickly becomes uneven, retains a large quantity of loose matter subject to decay, the whole giving rise at times to noxious odors. The effect, were sufficient of such paving used, would subject us to the conditions favorable to marsh fever. From a sanitary standpoint the cedar-block pavement of this country would indicate a serious menace to health. At the same time, while we are justified as a matter of theory in arriving at this result, there do not appear to be any statistics to prove the conclusion to be a correct one. The death-rate of cities most largely paved with cedar-block does not bear any ratio to the extent of such pavement; nor does a change from cedar-block to another less absorbent pavement produce a noticeable effect on the death-rate.

In European practice, wood more suited to a business street than macadam, affording a better foot-hold for horses than asphalt, less noisy than granite setts, is exceedingly popular in spite of its less sanitary character. In this country, however, there is an unwillingness to renew a wooden pavement when decay has rendered it unfit for further use, and this, coupled with the less careful method of laying, is the cause of the complete disrepute into which it has fallen. Experiments have been made recently by a Polish scientist with regard to cedar-block. The bacteriological examinations showed that, in specimens taken from blocks which had been in use for four years, and from a depth of one centimeter and two centimeters below the surface, there were at the end of five days 650,000, 220,000, and 12,100 bacteria per gramme of wood. A later examination showed 1,200,000 colonies per gramme in the surface of the wood, and 8,600 colonies per gramme at two centimeters below the surface. An estimate, in terms of its nitrogen, was made of the organic matter absorbed by the wood, and indicated that the surface layer of wood contains more nitrogen than the most polluted soil. A comparative estimate of the pollution of the atmosphere was made by placing a definite quantity of sulphuric acid under a glass bell, on the surface of wooden and asphalt pavements, the result, as indicated by the quantity of ammonia absorbed by the acid, being much in favor of asphalt. The observations show that while a wooden pavement gives absolute protection to the soil and to the subsoil water, there was considerable atmosphere contamination. The experiments were made on blocks of pine, preserved by impregnation with copper sulphate. Such being the case with a wooden pavement laid under European practice, there can be little doubt of the unwholesome effect of cedar-block upon the atmosphere. Further experiments of this description, conducted by members of your association, would doubtless prove instructive and profitable.

Broken stone or macadam would next arouse suspicion with regard to its absorptive qualities. There is this great difference between the two, however, that whereas a wooden pavement itself decays and affords food for the decay of other organic matter falling on it, the macadam does not in itself decay. With under-drainage such as well-built macadam roads possess, it should be little more than a good sewage disposal bed for the comparatively small amount of sewage which falls upon it. A macadam pavement can be scraped and swept, it is not noisy, dust can be subdued by sprinkling, and on sanitary grounds appears to be an excellent pavement for residential streets where traffic is not excessive. For business streets, or for heavily traveled thoroughfares of cities, a harder surface is advisable.

With regard to absorption, there can be no objection to asphalt, vitrified bricks nor stone blocks. Asphalt is impervious to water; while the joints of brick or stone pavements are practically perfect so far as absorption is concerned. To be sanitary a pavement should not be dusty. The dust of a pavement is not only an irritant, but carries with it the bacteria of disease which, from various sources, are a part of street filth. To prevent dust the pavement must be so perfectly cleaned that a practically harmless amount is taken up by the wind; or if perfect cleanliness is not possible, dust must be subdued by sprinkling. Unless perfectly cleaned, much more perfectly cleaned than is commonly the case in this country, an asphalt pavement is very apt to be a disagreeably dusty pavement on a windy day in summer. This, indeed, is one of its greatest faults from a sanitary standpoint. Toronto has the reputation of being a clean city, with a well-organized street department, yet even under these favorable conditions, a walk or drive down Yonge street on a warm, windy day is a very trying experience. The smooth, hot surface quickly dries any matter falling upon it, a wheel passing over this dry substance grinds it to powder, and the result is that clouds of dust find their way into the eyes, nose, mouth, throat and lungs of pedestrians. Business men in their offices are not safe from its attack, as it drifts in through the open windows. The dust imbeds itself in clothing, fastens itself on articles of food exposed in the shops, to be eaten finally by the purchaser. One case came to my notice in which a consumptive patient was ordered by his physician to leave Jarvis street, one of the best residence streets of Toronto, because of the dust which came from the asphalted roadway. These streets are swept by machines, and are hand-swept by a corps of city employees, but are not to my knowledge flushed as are similar pavements in London and Paris. Flushing is the only method whereby asphalt can be freed from this unsanitary dustiness, but in addition to being expensive and hurtful to the asphalt, such a proposal will doubtless meet the disapprobation of the engineer in charge of sewers. The dust, however, is not a defect of the pavement so much as it is a fault in the method of cleaning. Asphalt has, nevertheless, the disadvantage of being a very hot pavement. Its smooth surface, reflecting back

the heat and light, is productive at times of sun-stroke, and the glare is frequently painful to the eyes. This is most noticeable in closely built business sections where there is least circulation of air, where the sun beats down between high brick walls; and is not so objectionable on a shady residential street with houses well apart. Vitrified brick and stone block pavements are neither so dusty nor hot as asphalt since the surfaces are less smooth and assist in retaining in the joints the finer particles of dust. Sprinkling, too, is in a greater measure effective in subduing dust on brick or stone block than on asphalt, from the hot, smooth surface of which moisture evaporates rapidly. A macadam pavement is dusty if not properly treated, but it scraped and swept as are other pavements, the dust can be largely subdued by sprinkling. Noisiness, if excessive, is another unsanitary feature. A noisy pavement is jarring to the nerves, grating upon the sensibilities, and for either a heavily traveled business street, or a residential quarter, a quiet pavement is much to be desired. Noise itself is not always unhealthy. It is doubtful if the workman in a boiler factory, or a railroad engineer or other employee, is much influenced by the noise incidental to his occupation. Both are muscular of body, constantly taking vigorous exercise. But to the more sedentary man of business, whether at high nervous tension in his office or resting in the quiet of his home, a din, constant or intermittent, is a source of annoyance, and as such, is wearing on the nervous system. The most objectionable in this regard is granite or other stone block pavement. Vitrified brick is apt, unless great precautions are taken, to create a disagreeable rumbling. Asphalt, wood and macadam are the least objectionable with respect to noise.

While we have this to say of the comparative healthfulness of different varieties of pavements, there is another condition of matters common to too many towns and cities, in which the streets in fall and spring form a wilderness of mud and stagnant pools, and in summer are shapeless beds of dust. Many of them are made the receptacles of the refuse from private property, which is left to disfigure the street, forming rivers of filth and cess-pools of disease. Such streets have been regarded as a zero quantity, doing no particular harm, doing no particular good. Streets, however, which do no good, should do good, and therein lies the harm. A good street is a well-drained street, a well-cleaned street, and is a source of healthfulness to the members of the community. Streets should be the public parks, pleasing to the cultivated taste, adding to the culture and refinement of the people, and enticing them to breath health and vigor, whether walking, bicycling, riding or driving. Passing along the city street we reach the country highway, which, as a means of permitting the people of the city to leave the congested portions and to reside in the less thickly populated suburbs, forms an important factor in securing public health.

WOOD CARBONIZATION.

In the destructive distillation of wood, that is, ordinary charcoal burning, there are in the smoke or gas several valuable substances. These substances have been known for a long time and some have been partially recovered. The first process employed for the purpose was that for the production of tar from pine wood. Later, on the continent of Europe and in Scotland, wood was burned in retorts and the pyroligneous (that is crude acetic acid), was made into acetate of lime. Of late years, however, this business has had a very great development in the United States, where the large amount of excellent hardwood forests in the natural gas regions, where no wood is used for fuel, has given a very cheap raw material, making possible the export of acetate of lime and wood alcohol to Europe with profit.

THE CHARCOAL KILNS AT DESERONTO, ONT.

At present, there are two distinct processes used, called the kiln process and the retort process. In the kiln process the cord-wood is put into a large brick or stone "beehive" kiln and burned in the ordinary manner for producing charcoal, but the smoke or gases do not escape into the air, but are drawn through a chimney into a series of condensers, where all the liquid products are condensed out, and the gas is burned under the boilers. The liquor condensed (amounting to 180 gals. for a cord of well-seasoned dry wood), is led into tanks and the tar is separated out. This tar is redistilled, producing oils and pitch. If only wood alcohol is to be made, the settled liquor is distilled and crude alcohol produced and the residual pyroligneous acid is run to waste. If brown acetate of lime is to be made, the crude liquor is neutralized with lime before the alcohol is distilled off. If gray acetate of lime is to be produced, the crude liquor is all distilled and purified before neutralizing with lime. This method gives the best product, the gray acetate of lime containing from 82 per cent. to 86 per cent. of acetic acid, while the brown acetate of lime sometimes contains less than 60 per cent. of acid. The retort process differs from the kiln process of carbonizing in having the cord-wood put into horizontal wrought-iron cylinders, and these are heated by a fire-place beneath them. In the kiln process, enough air is let into the kiln to burn a portion of the wood, and this heat serves to carbonize the rest. The retort process is superior to the kiln process in giving larger yields of valuable products, but the cost of installation and of working is greater.

The by-products in the liquors from the condensers are recovered the same way, whether produced by the kiln or retort process. In all the processes the alcohol is re-distilled, purified and treated chemically, and brought up to a strength of 95 per cent., before being put on the market. The products of this industry are used in the arts for various purposes. Wood alcohol or methyl alcohol is like grain alcohol in many physical properties, but is poisonous. It is used for making spirit varnishes for burning and dissolving various gums, and by the government for making methylated spirit. Acetate of lime is used for the production of acetic acid, which is the acid of vinegar, and is diluted and flavored and sold for this purpose in Russia and other European countries.

The Standard Chemical Co., Limited, first introduced the retort system into Canada about a year and a half ago at Fenelon Falls, Ont. Previous to this, the only works in Canada turning out these wood products, were located at Deseronto, and owned by The Rathbun Co., which owned the patents for the Burrel

Kiln process. H. O. Chute, superintendent of the company, was employed by the Standard Chemical Co. to erect a retort plant at Fenelon Falls, which has been in operation since last fall. When the Deseronto Iron Co. decide to locate at Deseronto, assuring a market for the charcoal, the Standard Chemical Co. acquired the rights of the Burrel patent, owned by the Rathbun Co., and decided to enlarge the plant by putting in retorts. This plant will have the largest single bench of retorts in the world, and many new features of construction are being introduced, which allow of a more economical working and handling of all products by machinery. We are indebted to H. O. Chute, superintendent of the Standard Chemical Co., for the information contained in this article.

THE OTTAWA VALLEY CANAL.

The report of the special committee of the Dominion Senate, appointed to examine into the feasibility and advantages of a water-way connecting Lake Huron with the St. Lawrence, via the Ottawa river, has been published, and is accompanied by three maps of the proposed Montreal, Ottawa, and Georgian Bay Canal, including a plan and profile. The report as issued seems to be entirely in favor of the construction of the work. The witnesses examined, who included S. A. Thompson, Duluth, U.S.; Major-General Gascoigne, at the time Commander of the Canadian Militia; Marcus Smith, M. Inst. C.E., Ottawa; James Meldrum, M. Inst. C.E., London, Eng.; O. Higman, Dominion Electrician, Ottawa, and H. K. Wicksteed, C.E., Cobourg, Ont. A series of questions were also sent out to a large number of those who might be supposed to be either most familiar with the locality and the nature of the construction required in the particular work in question, or whose knowledge of like questions and of transportation generally gave their opinion weight with the committee. Replies were received, among others, from Sir Wm. Van Horne, Walter Shanley, C.E.; T. C. Clark, M. Inst. C.E., New York; Andrew Bell, C.E., Almonte, Ont., and R. W. Shepherd, Man. Dir. of the Ottawa River Navigation Co.

The bright side of the picture seems to have been presented to the Senate more fully than the reverse. There are several features of the proposed work which are not very fully dwelt on in the report. The estimates of the cost discussed were largely those proposed for a twelve-foot waterway, and the canal under discussion is to have a depth of fourteen feet. The report of T. C. Clark, M. Inst. C.E., made in 1860, is quoted, in which he says: "The distance is 430.76 miles, of this 351.81 miles are already a perfect natural navigation, and require no improvement, and it is perfectly practicable so to improve the remaining 78.95 miles as to convert the whole chain of water into a first-class navigation for steam vessels, and to reduce the length of canaling 29.32 miles, or exclusive of the Lachine Canal, to 20.82." In the late report he says: "To improve the navigation of such a river system is comparatively easy, for the greater part is already accomplished." Marcus Smith, M. Inst. C.E., in his evidence before the committee, says of the river stretch: "I think there is only one place in the Ottawa that we need to make any dredging at all for twelve feet, but there may be some more for fourteen feet." The evidence seems to point to the use of the Ottawa river as part of the canal in its present state, or when improved at a comparatively low cost. The witnesses, who were heard through their answers to the series of questions, had not the same opportunity to bring forward all the facts at their command as had those who were examined by the committee. Andrew Bell, C.E., is quoted in the report as speaking enthusiastically of the electrical possibilities of the water along the canal, but does not give any evidence as to the condition of the lower Ottawa. Mr. Bell was the engineer in charge of the construction of a government dam in the Ottawa river at Carillon, and is very well posted on the subject of the Ottawa river. In an article published in THE CANADIAN ENGINEER in August, 1897, Mr. Bell says: "At present not more than eight feet depth for navigation can be depended on between Lachine and Ottawa city, in low water." Some of the engineers giving evidence were in doubt as to nature of the bottom of the Ottawa. Mr. Bell made extensive surveys, 1870—1882, from above Grenville to below Carillon, and (by an assistant), above and below St. Ann, and he states that "the lower Ottawa flows over limestone rock." There appears then to be a very serious problem in adapting the present navigation of the Ottawa to the demands for increased depth. The report made by the Senate committee seems to show how incomplete is the information before the public, and how necessary it is that a careful examination of the whole place should be made, and preliminary surveys carried out before the government affords any assistance to the scheme, either by a money grant, or by lending its credit by a guarantee of interest per term of years, as has been proposed.

In a paper read before the Royal Society of Canada in 1893, T. C. Keefer, C.E., C.M.G., stated that: "The Ottawa route would be most valuable to Lakes Michigan and Superior ports, as affording much the shortest water route to tide-water at Montreal, and also at New York, via Lake Champlain, if the barge system of transportation proves to be the most efficient and economical. Hydraulic lifts, or pneumatic locks, may yet bring the shorter and shallower water routes into competition with the St. Lawrence; but as long as boats are kept in their native element, the broad deep channel of the St. Lawrence will remain the only one which can successfully compete with the railways."

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

(Concluded from last issue).

Well-holes should be avoided if the building is to be regarded as "fire-proof." It is almost impossible to control a fire starting in the lower floors where a well-hole opens through those above. Luxfer Prisms are now used to secure light from side windows, it is claimed, with great success. A recent fire test of the Luxfer Prism, in Chicago (March, 1898), is stated to have been satisfactory to Fire Marshal Swenie, as showing that these prisms afford material protection from the heat of a neighboring fire in an exposing building, and that, to some extent, they are substitutes for iron shutters. These should be in hallways cut off from the rooms at each story by fire walls and doors, to prevent draughts. It is not so important, and is not so practicable, in the case of office and hotel buildings as in the case of mercantile and manufacturing buildings; but it is advisable, even in office buildings, to have the staircases, elevators, etc., in a separate hallway, the division walls of which should extend through and above the roof, and any skylights should be covered with glass not less than ¼ inch thick. It is contended by some that skylights should be of thin glass, so that they will break easily and permit the escape of smoke and

gas. Smoke is inflammable, and when it accumulates in a building, often spreads the fire from story to story, or blows out the walls by the explosion of its gases. But while thin skylights are contended for by many expert firemen, it should be borne in mind that nothing so facilitates the spread of fire as a draught, and it would be better to have the skylights adjusted with appliances for opening them, so that when the firemen arrive on the ground, and not before, they may be adjusted to permit the escape of smoke and allow the firemen to enter the building to see where to work to the best advantage. Under any circumstances a network of wire should be above the glass to guard it against flying embers, and another should be suspended beneath the skylights, so that when the glass cracks and breaks with the heat it will not injure the firemen below.

Roofs should be of brick or tile on all high buildings, the roof beams being of iron and, where tanks are supported, of sufficient strength to carry many times the actual probable weight of the water and the containing tank itself. Slate roofs, on very high buildings especially, on street fronts are objectionable, as, in case of fire, the slates would crack and, falling to the street, injure the firemen. A flat roof of brick tile is better than any other. All water on roofs from rain or melting snow should be drained from the front or sides to leaders, so as to avoid drip points, from which icicles could be formed.

The electric light installation of a "fire-proof" building is an important and complicated matter. The switchboard should be of combustible material, and no steam, water, or sprinkler pipes should pass over or near it where, in case of a bursting pipe, water could reach the switchboard and cause disaster. This is an important matter almost universally overlooked. An admirable floor for a dynamo room is one of deck glass, ¾ inches thick, on a wooden (not iron) frame. It will insure that the attendant upon the dynamos will be, at all times, effectually insulated. Such a floor will not become soaked with oil, as would a wooden floor, and can easily be kept clean. A strip of rubber floor carpet stretched over it will prevent slipping.

It is sometimes necessary to have communications between adjoining buildings by doors in the fire walls, and it is not always convenient, for changing merchandise from one room to another, to have "fire-proof" doors closed during working hours. It is possible to have the "fire-proof" doors run upon trolleys on an inclined track, so as to close by the force of gravity and held open by fusible metal latches or links which would release them when melted by the rising temperature of a fire. It has occurred to me that this difficulty may also be met by erecting between two adjoining buildings a separating "fire-proof" hallway of brick, which can be utilized for containing staircases and elevators, and for supporting the water tanks of automatic sprinklers. The doors which open into this hallway should not be opposite each other, but at opposite ends of it, so that fire in one of the buildings passing through the door would come against a blank wall opposite. Even if the "fire-proof" doors to these openings should happen to be open at the time of a fire in one of the two buildings, it is improbable that it would find access to the other. The floors should be both fire and water proof, slightly lower than those of the two separated buildings, and with water vents or "scuppers" for carrying off surplus water thrown by a fire department. Indeed, it is well to have "scuppers" on all floors of every building. The walls of this separating hallway should rise 4 feet higher than the roofs of the two buildings, and, if there are window or door openings near it, its walls should project beyond the line of enclosing walls at least 1 foot.

The water tank, as already stated, should be supported on protected iron I-beams, resting on the brick walls, with cast-iron templates, so that the tank cannot fall, break down the staircases and wreck the building in case of fire. It is important always to locate tanks so that they will not be over stairways or elevators, and endanger them in case the supports give way. With a "fire-proof" hallway of the kind recommended, containing no combustible material whatever, the tanks being supported by iron I-beams resting on the brick walls, this would not be an important matter, but in all other cases water tanks should be planned so as not to endanger staircases, and the supporting iron beams should be "fire-proofed," that is, covered with "fire-proof" material. It ought to be unnecessary to state that there should be no combustible material whatever in this separating hallway, and that the staircase, elevators, etc., should be of metal and "fire-proof." Indeed, such a hallway as this could be relied upon to separate wooden buildings. It should, however, for that purpose, be at least 10 feet higher than the peak of their roofs, and should extend 4 feet beyond their front and rear lines.

Where it is not necessary to transfer merchandise from one building to another, and only requisite to have a passageway for employees, this may be arranged by an iron balcony, like a fire escape, cutting down the window on each side of the separating wall for a door, so that communication can be had by the balcony. The openings should have "fire-proof" doors. This would be practically safe. It might, with iron ladders, be utilized as a fire escape, and so prove of great advantage to firemen in fighting a fire, who could hold a hose nozzle at the different windows with perfect safety to the last moment. It is practicable, indeed, to have iron stairways with roofed balconies entirely outside of storage stores so that the floors do not communicate. There are a number of these in Philadelphia.

These should not be of iron, but of wood covered with tin. Solid iron shutters or doors are not reliable. Iron doors yield readily to flame, resulting sometimes in their warping open when exposed to fire in an adjoining building, exposing the one they are intended to protect to the full effect of the flames. Where window openings are protected by iron shutters on rear courts they are almost certain to be opened by a fire in an exposing building, and cannot be relied upon. The tin covered wood shutters are alone reliable. There is no recorded instance in which a solid iron door, exposed to the full effect of fire in an adjoining building, has protected the opening, whereas there is, on the other hand, no recorded instance in which the "Underwriters'" door has failed to serve its purpose—two important facts which are significant and ought to settle the question. The "Underwriters'" door is constructed of ordinary white pine lumber, free from knots, of double or treble thickness, according to width of opening, the boards being nailed diagonally and covered with the best quality of tin, with lap-welded joints. It ought to be unnecessary to state that on the exposed side of a building, not only the shutter, but the window-frame, sash, etc., should be of metal or covered with metal—riveted, not soldered. Where it is not possible to use a "fire-proof" shutter for want of room, wire glass in a metal frame will be found a desirable substitute. It will probably hold a fire until the fire department can cope with it. It is not generally understood nor known that fire will travel from one story to others above by way of the windows in the outer or enclosing walls. Especially where a building has an enclosed court, it will sometimes reach upper stories in this way, even when the floors themselves are thoroughly cut off, the court acting as a chimney.

It may be well to suggest for the benefit of those who are not familiar with city fires that, as heat naturally ascends, the exposure of a low building is often much greater to a neighbor higher than itself than to a building of its own height, so that a tall, "fire-proof" structure, surrounded by smaller buildings, should be provided with fire shutters to all openings. These are not necessary where the exposing buildings are occupied for offices, and are themselves "fire-proof," as the amount of heat which escapes from the windows of a burning building, so long as its enclosing walls remain intact, is seldom sufficient to ignite a "fire-proof" building or its contents. The moment of greatest danger is when a burning building collapses, and the intense heat caused by its enormous bed of coals, exerts its full effect upon surrounding structures. In a recent fire in New York three "fire-proof" office buildings were more or less damaged with their contents, although many feet away from the burning building. It is to be hoped that some inventive genius will devise a plan for simultaneously opening or closing the shutters on any or all stories of high buildings by manipulation from the ground floor. They are usually left open at night, always in the day time, and might thus be closed in case of a dangerous fire in the vicinity. In some cases they are fastened open.

Tests of "fire-proof" material, iron beams, pillars, floor arches, etc., to be of any value must be conducted under circumstances which insure uniform conditions. Otherwise comparisons are unreliable. It is quite customary to refer to results of fires in different buildings, having differing forms of construction, as supporting theories of relative merit; but ordinary conflagrations cannot be relied upon, for the reason that in two buildings, side by side, the conditions may be widely different

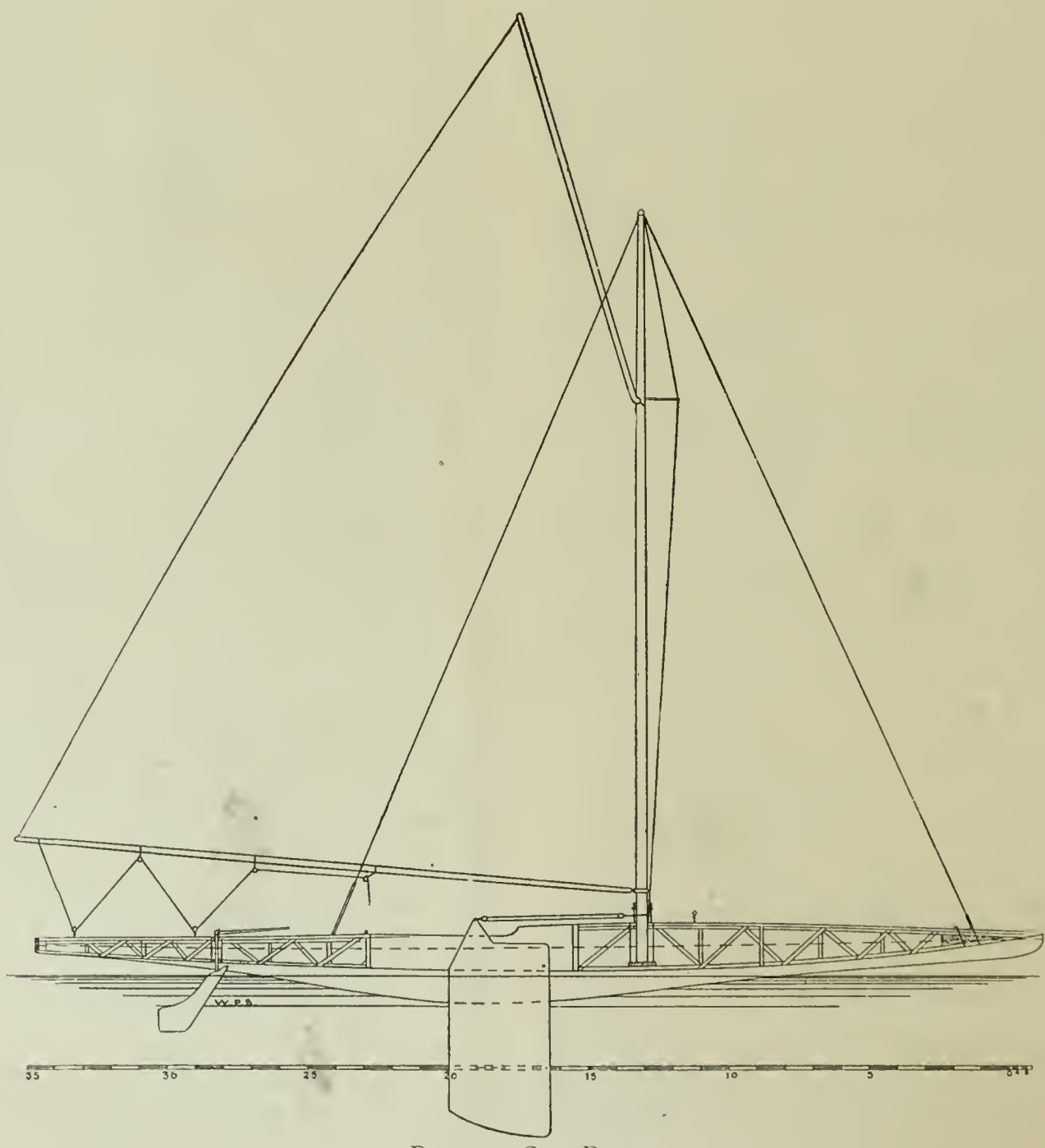
Eddies and currents of air, changes of prevailing wind, etc., may secure exemption from damage. It happened in the large conflagrations of Chicago, Troy, Boston, etc., that the most phenomenal escapes were observed. In some instances frame buildings, surrounded by brick structures which were totally destroyed, escaped with no further damage than the blistering of paint.

Even where tests are carefully arranged, especially weigh tests, obvious precautions are sometimes overlooked. It will be observed, for instance, where bricks are piled on a surface of floor arch and iron beams to secure a certain weight per square foot, the pile of bricks may be so disposed as to have a bearing on both of the iron beams, and the full weight may not come upon the "fire-proof" arch between them. The lateral bond of a pile of bricks a few courses higher than the floor to be tested may have all the effect of a relieving arch and materially reduce the strains. In furnaces constructed to secure high temperatures, drafts and currents of air should be provided for with great care and under the direction of the most competent and intelligent experts.

THE DOMINION.

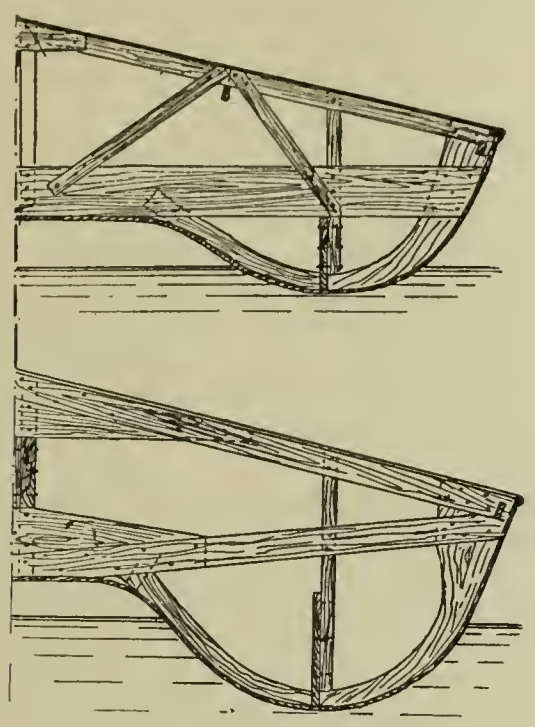
The 20-foot yacht Dominion, built to defend the Seawanhaka international challenge cup, upon the design of G. Herrick Duggan of the Dominion Bridge Co., Montreal, is a racing machine which has already aroused a lively discussion that is likely to result sooner or later in a radical revision of the rules governing the class, and possibly of the general rule governing all the smaller classes, says Forest and Stream, from whose pages we reproduce the accompanying plans. The situation at the present time seems to be that either this new type must be recognized as legitimate in all classes, or some material change of the rules must be made to bar the entire scow type to which she belongs. The dimensions of Dominion are: Length over all, 35 ft. 10 in., l.w.l. 17 ft. 6 in.; beam, extreme, 7 ft. 7½ in., l.w.l. over all, 7 ft. 1½ in., l.w.l., one bilge, 2 ft. 5½ in.; draft, hull, 10 in., with board, 6 ft.; freeboard, 1 ft.; sheer, bow, 3 in., stern, none; displacement, 1750 lbs.; area midship section, total, 2.88 sq. ft.; sail area, 500 sq. ft.

In many details Dominion is no more remarkable than others of the 20-foot class produced within the past two years. The "barn door" deck plan has been seen on other boats. The notable departure that has aroused so much hostile criticism is the hollowing of the floor, so plainly shown in the body plan. The object of this is to perfect the form of the bilge when sailing (as all the boats of the class are sailed) at an extreme angle of heel, and with the entire weather side of the boat clear of the water. The rig and general fittings are much the same as in other of Mr. Duggan's boats, Speculator and Strathcona of this year, and Glencairn, Avoca, Glenowen and others of last year. The centreboard is built up of wood and sheet steel, weighing about 250 lbs., or about 150 lbs. less than in last year's boats; it is situated amidships, in the centre of the hull, as in the other boats. The rudder is of a different form from last year, very wide below, but is of the same construction, a light iron tube for stock, two sheet steel sides, and wood filling, making a strong and light piece of work. The rig is of the same length on the foot, and the centre of effort is at the same height as in Glencairn II., but the gaff is peaked up, making a higher rig. All of Mr. Duggan's sail plans this year show these same proportions, looking like Momo of last year. One of the peculiar features of Dominion is the shape of her deck. The boats of last year were distinguished by a great crown and a peculiar curve to the beams; this year, in Dominion, the curve has been abandoned, each side of the deck running up straight to a ridge in the centre, like the roof of a house. This plan gives a great depth where it is needed, above the highest part of the floor, and especially for the housing of the mast, it aids in the transverse trussing, and it gives a weather deck that



DOMINION SAIL PLAN.

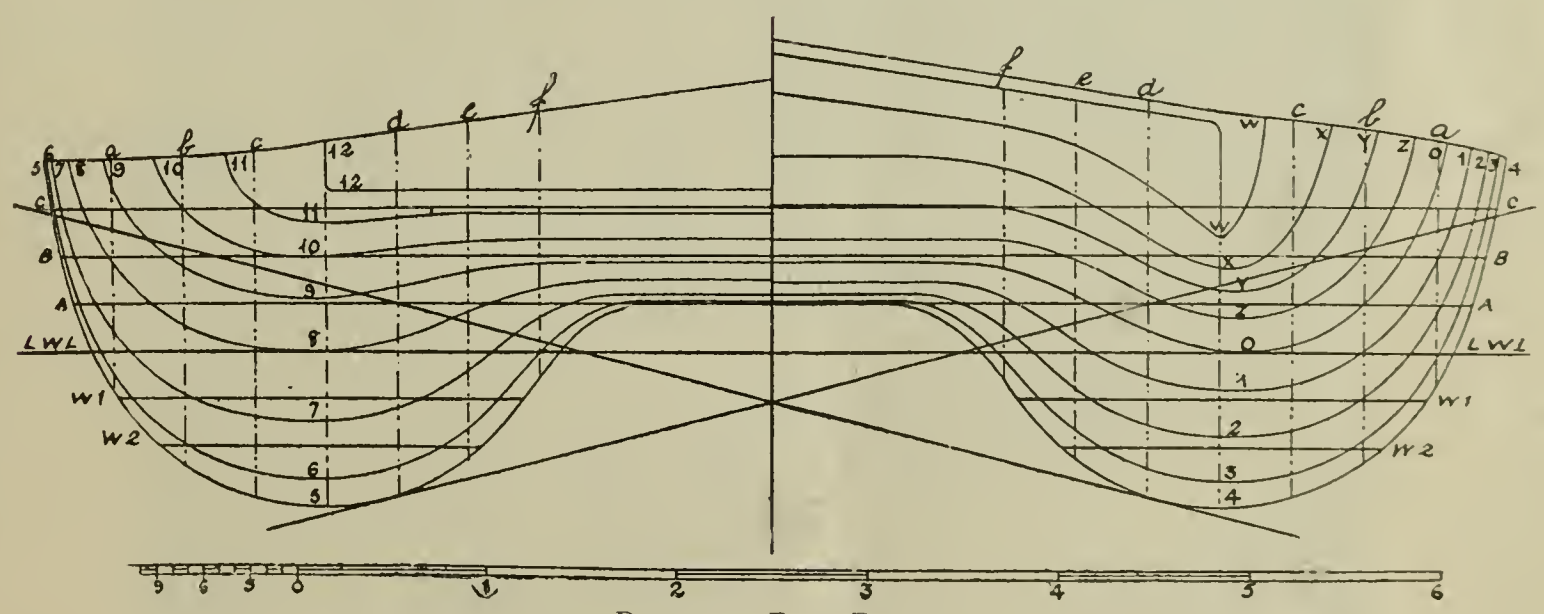
in sailing is flat and almost level. The cockpit is comparatively small, but it is carried down to the bottom, its floor being merely light strips laid on the floors. There are no bulkheads, the boat being open from end to end. The great length of the yacht, the large area of deck, the limited depth, due to the hollow under the floor, and the fact that only one side of the hull is water-borne at a time, with the absolute necessity for a



DOMINION—SECTION SHOWING CONSTRUCTION.

light hull, made the problem of construction a difficult one; but it was successfully solved by Mr. Duggan, who planned the entire construction and followed it closely during the building; the yacht being built at the shop of the Yacht Company of Canada, on the yacht club grounds at Dorval. So far as tested by the trial trips, practice sails, trial and cup races, the construction is a success in the important detail of strength, as the boat showed no signs of strain. One special point in favor of the construction is that only the cheapest and simplest materials were used, such as are found in any boat shop, and there was no call for special skill on the part of the workman.

The first point in the construction was to secure a sufficient depth of hull amidships, by means of a central ridge, giving depth for a fore and aft girder, and also stiffening the transverse trusses. The fore and aft trusses are located, one in the centre of each bilge and the third exactly between these two, in the centre of the hull. The lower member of each side truss is a vertical keelson of 5/8-in. white pine, 8 inches wide amidships; the posts are of white pine 1 by 1 inch, and the diagonals of the same wood 3 by ½ inch. There are transverse trusses spaced 2 ft. 2 in., forming the main and deck frame, also of ½-inch white pine, from 1¼ inch to 3 inches wide, the curved members being merely sawed off from straight stuff without regard to the grain. The members were carefully disposed and well fastened by numerous boat rivets. At the two after stations under the travelers, solid frames are used, and at the partners solid planks are used above the level of the middle floor. The skin is laid shiplap, of about three-eighths thickness, with three light bent frames between each of the trusses. The deck is also laid shiplap, just under three-eighth inches. The weakest point in boats of this class has been about the mast, there usually being no keel or keelson to carry the weight. In Dominion the mast step is suspended by four three-eighth inch steel bolts from two fore and aft pieces of oak, about 2 by 2 in., running over the top of the transverse trusses and transmitting the strain to several of them. In this way there is no direct strain on one point of the bottom. The construction, as a whole, is simple, cheap, homogeneous and apparently amply strong and durable. In these respects it compares favorably with that of the Crane boats, which was ingenious and carefully worked out, but at the same time calls for material unknown in boat shops and unfamiliar to the average boatbuilder, and depending for success on the use of metal in combination with wood instead of one material alone.



DOMINION—BODY PLAN.

WATER POWERS OF ONTARIO.*

BY THOMAS W. GIBSON.

In speaking at Buffalo, N. Y., January 12th, 1897, on the occasion of the introduction into that city of electric power from Niagara Falls, Mr. Nikola Tesla, perhaps the most celebrated of living electricians, spoke of a tremendous problem yet to be solved in the production of power, to the elucidation of which he had devoted a great deal of attention. Without describing the nature of this problem, he spoke of it as an effort to "evolve means for obtaining energy from stores which are forever inexhaustible, to perfect methods which do not imply consumption and waste of any material whatever." Even if this stupendous achievement were accomplished however (as he had little doubt it would be), he said his investigations led him to conclude that "under the theoretically best conditions such a method of obtaining power cannot equal in economy, simplicity and many other features the present method involving a conversion of the mechanical energy of running water into electrical energy, and the transmission of the latter in the form of currents of very high tension to great distances. Provided therefore that we can avail ourselves of currents of sufficiently high tension, a waterfall affords us the most advantageous means of getting power from the sun sufficient for all our wants, and this recognition has impressed me strongly with the future importance of the water power, not so much of its commercial value, though it may be very great, but chiefly of its bearing upon our safety and welfare."

If Mr. Tesla's conclusion be correct, namely, that a waterfall affords us the most advantageous means of getting power from the sun for all our wants, excelling for this purpose not only muscular force, but wind and steam as well, the rocky uplands of northern and western Ontario may yet be reckoned

*Extracted from the report of the Ontario Bureau of Mines, 1898. Vol. V Part III.

among the most valuable parts of the province by reason of the vast number of waterfalls situated there. The main watershed dividing the system of the great lakes from that of Hudson Bay runs in a northwesterly direction from the eastern boundary of the province north of lake Temiscamingue to the head of lake St. Joseph on the northern boundary, a distance of about 500 miles. It consists of a tableland or plateau rather than a sharply defined ridge, and is estimated to have an average width of about 70 miles, or an area of about 35,000 square miles, thus with the slopes on both sides affording an extensive catchment surface for the streams running to the north and south. Its elevation will average perhaps 1,400 or 1,500 feet above the level of the sea, or 900 feet above lakes Huron and Superior. In places it approaches the shore of the latter lake, and for the greater part of its extent is situated at a comparatively short distance from either of these bodies of water. The consequence is that the rivers and streams which flow from it into the great lakes, though mostly of considerable volume, are not of great length, and their descent is therefore usually rapid and abrupt, and marked in many places by cascades and falls.

The value of a river of given volume for purposes of water power does not altogether, or even chiefly, depend upon the amount of its fall from source to mouth. Of course the greater the fall the greater the energy possessed by the stream as a whole. But it is apparent that if the descent be gradual and uniform, or approximately so, there will be few places in its course where the fall is large enough to afford any considerable quantity of power. It is only where sudden falls or rapids occur, which create a decided difference in the level of the water, that the energy of the river is concentrated, as it were, within a short space, and can be utilized. The nature of the soil or surface of the country through which the river runs has an important effect in influencing the habit of the stream in this respect, and so determining its value as a producer of power. If it be composed of sand, clay, gravel or even the softer and more easily decomposed rocks, it will usually be found that the river has worn its bed to a fairly uniform slope throughout, in which case there will be few opportunities of developing power from its waters. Even if a slight drop should occur, a dam would probably be required in order to obtain any considerable head, and the erection of dams, while often necessary and advantageous, involves additional expense both in construction and maintenance. In a river whose bed is composed of hard rock, such as is usually comprised in the Laurentian and Huronian formations of northern and western Ontario, the eroding force of the water meets with much greater resistance, and its course is more likely to be marked by abrupt changes of level in rapids and falls, and indeed this is characteristic of many if not most of the rivers in those parts of the province. Another prominent feature of the topography of these districts is the very large number of lakes, varying in size from mere ponds to large and important sheets of water. These are either the sources of or tributary to the rivers, or expansions of them, and act as reservoirs or storage basins, tending to regulate the flow of the water and to render it constant and steady throughout the year.

The character of the country in northern and western Ontario is therefore such as to provide an almost illimitable amount of water power readily available. Taking into account the annual precipitation of moisture in the form of rain and snow, there is no reason to doubt that hundreds of thousands of horse power could be generated from the waters of streams flowing into the great lakes with a minimum of trouble and expense. A shorter watershed running from the main one southwesterly round the western end of lake Superior divides the streams falling into that lake from those which find their way into lake Winnipeg and so into Hudson Bay, and the waters running in both directions from this divide furnish many fine water privileges, similar in character and equally available; while tributary to the Ottawa river, and in that part of the province included within the boundaries of Algonquin National Park, as well as to the south and west, are numerous rivers of considerable fall and volume from which a very large additional amount of power could with little difficulty be obtained. The streams flowing into Hudson Bay, such as the Albany, Kenogami, Missinaibi, Mattagami and Abitibi are of greater average length than those running into the great lakes, and as they descend to the level of the sea, say 600 feet below that of lakes Superior and Huron, many falls are to be found upon them, particularly in their upper reaches and in the neighborhood of the "long portages," where their waters are interrupted by the hard rocks of the old formations on their way to the more level Devonian plains bordering on James Bay. For the present, however, these rivers are too remote to be regarded as sources of available power, though the time may come when they will be called into requisition. But on the Seine, Atikokan, Wabigoon, Winnipeg and Rainy rivers, on the Mattawin, Kaministiquia, Nepigon, Steel, Pic, Magpie and Michipicoten, on the Mississaga, Thessalon, Spanish, Vermilion, Wahnapitae and Sturgeon, on the Montreal, Ottawa, Petawawa, Bonnechere and Madawaska, on the Muskoka, Maganetawan and Severn, and on many others there are numerous falls and rapids waiting to be utilized and capable of doing the work now being done by all the steam engines in Ontario a hundred or a thousand times over. This is leaving out of view the waterfalls already developed and in use in the older portions of the province, as well as the stupendous energies of the falls of the St. Mary and Niagara rivers, which are already, one on the Canadian and the other on the American side, to some extent made use of.

The rivers enumerated above are situated among the forests of pine and hardwood, which cover so considerable a portion of New Ontario, and in many cases they are contiguous to valuable deposits of ore or mineral. The raw material for many industries lies around them. The sawmill, planing mill, sash and door factory, pulp mill, match factory and many other woodworking industries might happily combine abundant raw material and cheap power on these streams, while stamp mills and other mining plants might be worked with profit and success. Other industries, such as woolen, cotton and flour mills and chemical manufactories might avail themselves of the cheap power without necessarily locating in the immediate neighborhood of the waterfall, by connecting themselves with it by means of the electric current, though for textile, paper and other industries whose processes necessitate the use of large quantities of clear water, a waterfall convenient to means of transportation forms an ideal site. Electrically driven railways seem likely to come into vogue in this and other parts of the world because of their low first cost and inexpensive maintenance, and it appears feasible to operate electric roads by currents generated by the waterfalls on the rivers in many parts of the districts referred to. Such railways might serve a very useful purpose in carrying lumber, ore, raw and finished material and supplies of all kinds in a country where perhaps the volume of traffic might not be sufficient to render an ordinary steam railway a profitable undertaking.

Water power, whether employed directly to operate machinery, or converted into electric energy for the same purpose, has many advantages over the steam engine. For the same quantity of power, its first cost is not usually much greater, and often not so great, and once installed it requires little or no attention. Its danger to life and property is less. It needs no fuel, a consideration specially important in Ontario, which has no coal beds, and where in time even the present abundant supplies of wood will be exhausted. Hitherto the chief disadvantage of water power has been its immobility. If a waterfall was not conveniently situated, it was of little or no use. If it did not pay to place a manufactory alongside a waterfall, the fall could not be brought to the factory. Now this has to a large extent been changed and power can be delivered without serious waste many miles from where it is electrically produced. The change will be still more marked when the problem of transmitting electric energy through long distances has been thoroughly solved, and Nikola Tesla looks forward to a speedy solution.

The presence of so many available water powers in the Lake of the Woods, Seine River, Wahnapitae and other mining districts of Ontario is a fortunate circumstance, and cannot but have a very favorable effect upon their development. Cheap power means economy in working, and will permit of ore bodies being profitably utilized which would otherwise not pay for treatment. The immense deposits of low grade ore which are found north of lake Superior and on the Upper Seine are in many cases situated in proximity to waterfalls capable of yielding hundreds and thousands of horse power at comparatively little expense. The importance of preserving these water powers as far as possible for the general benefit and preventing

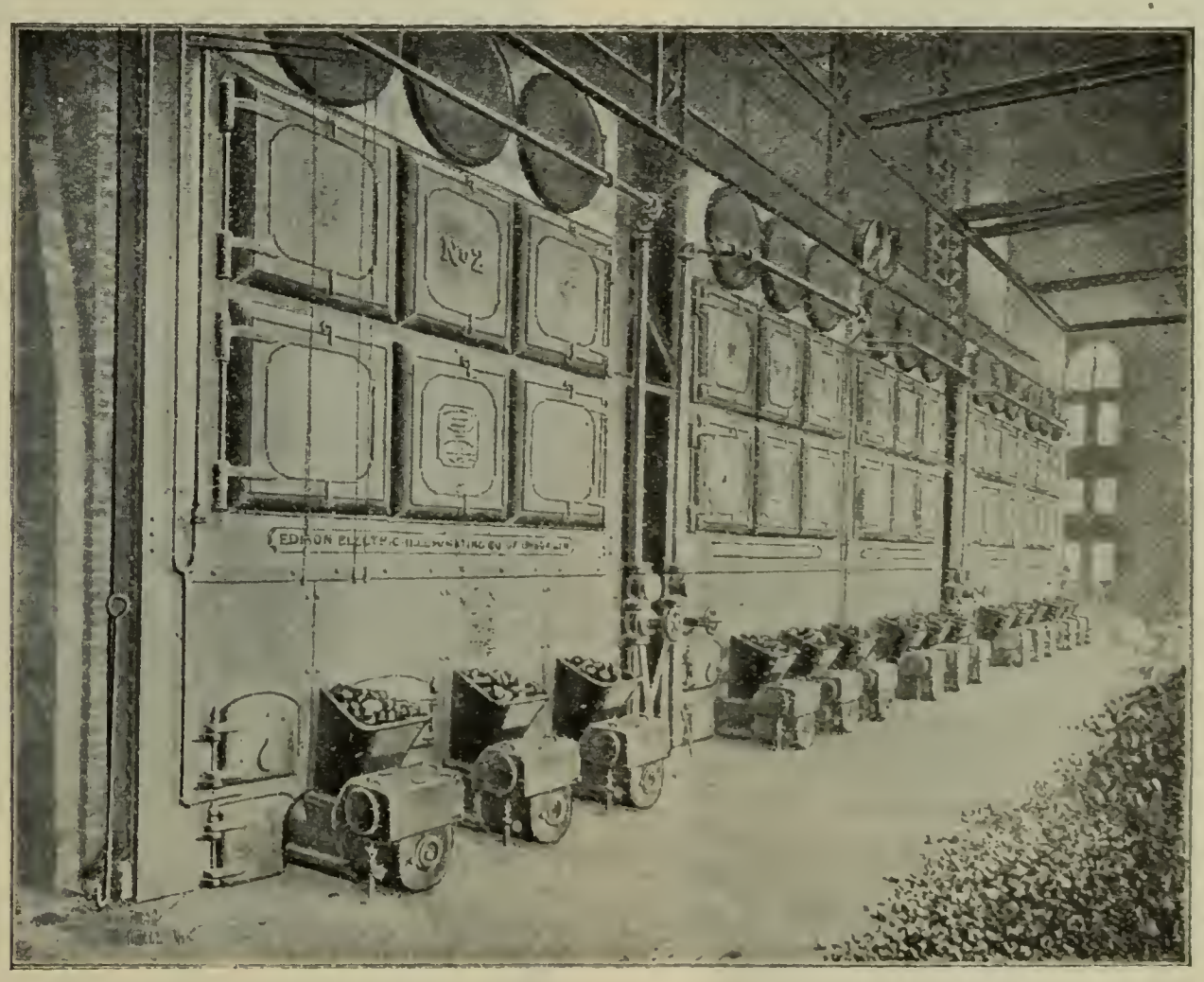
their being locked up in the hands of speculative individuals who would not use them themselves, but who would demand heavy toll for their use by others, has led to the adoption of new regulations under the Act respecting Water Powers, (61 Vict., chap. 8), passed at the last session of the Legislature. The principal features of these regulations are those which provide for the leasing of such powers by the Crown, instead of patenting them outright, and for the furnishing of surplus power by the lessee to others on terms to be fixed in case of disagreement by the Lieutenant-Governor-in-Council.

—The largest dynamo in the world is now being constructed by the Walker Co., of Cleveland, O., for the Boston Elevated Railway, Boston, Mass. This generator will have an output of 3,000 k.w. at 550 volts, or about 4,000 h.p. Its speed will be between 75 and 80 revolutions per minute, its total weight 250,000 lbs., and the diameter of the circular cast-steel field frame 21 feet, 7 inches. The weight of this ring without field magnets will be 25 tons. There will be 24 inwardly projecting laminated cores and pole having a combined weight of 15 tons. The armature hub is 13 feet in diameter and is in two parts, each of which weighs 10 tons. The shaft is 37 inches in diameter. The armature laminations add 15 tons, and the armature will have in all 594 slots. The commutator will be 105 inches in diameter, and will have 1,183 bars. To facilitate regulation and remove a portion of the strain from the shaft, the flywheel will be bolted directly to extensions on the armature hub. If this machine were to run at the speed of the Niagara generators, 300 revolutions per minute, it would have an output of 16,000 h.p.

and do away with the principal difficulty—the odor from escaping gas. In view of the experience he had he discarded galvanized iron generators with rubber connections entirely, and a system that depended entirely on a water seal to retain the gas. "My new generator," writes Mr. Holland, "is made entirely of cast iron, with iron pipe connections and brass valves. It made its trial trip on Oct. 11th in a Gatineau Valley car. It proved to be a perfect success. The lights burned brilliantly throughout the trip, lasting 4½ hours. With six lights of 25 c.p. each the car was illuminated so well that I could read the evening papers with comfort from any seat in it. The vibration over the roughest part of the road had no effect on the lights, and better than all there was absolutely no overflow or leakage of gas. I am now at work on another apparatus designed specially for locomotive head lights. I expect to have it in operation shortly, and that it will be as complete a success as the car lighter."

THE AMERICAN STOKER COMPANY.

We publish herewith a series of engravings made from photographs representing the Dominion Cotton Company's Mill at Hochelaga, Que., prior to and after the installation of the American Stoker Company's apparatus in the boiler house. The second series of pictures almost give the impression that the mill is closed down, but on entering the mill, however, it is found that everything is in full swing, and on going into the boiler house at the time these photographs were taken, it was seen that the whole of the steam plant of about 700 h.p. was in operation, the boilers being fired by means of the American Stoker Co.'s apparatus with soft coal screenings. The photographs were taken at the request of the Dominion Cotton Co., by Mr. Dennison, photographer, St. Catherine street, Montreal, and Mr. Dennison went to the site and took these photographs without the knowledge of any one connected with the cotton mill. The series is taken at intervals of ten minutes to show that no special advantage was taken in selecting the moment of exposure.



PLANT EQUIPPED BY THE AMERICAN STOKER CO., SHOWING THE AUTOMATIC STOKERS AS IN USE AT UNION STATION, EDISON ELECTRIC ILLUMINATING CO., BROOKLYN, N.Y.

ACETYLENE GAS LIGHTING FOR TRAINS.

In response to an enquiry as to the progress being made in car lighting by acetylene gas, A. Holland & Son, Ottawa, Ont., write that they are adopting a new system, because though the generators in use on the Pontiac & Pacific and Gatineau Valley railways give beautiful light it has been found they are troublesome to keep clean and charge, and the overflow of gas causes a bad smell in the car that is very offensive to some persons. Mr. Ressman, who is fully impressed with the future of acetylene as a car lighting gas, urged Mr. Holland to try and make a machine that would absolutely control the gas

The stoker is thus described by its makers: "Immediately beneath the coal hopper, and communicating with it, is the conveyor pipe; this in turn communicating with the coal magazine. A screw conveyor or worm is located in the conveyor

JULY 22ND, 1898—10 00 A M.

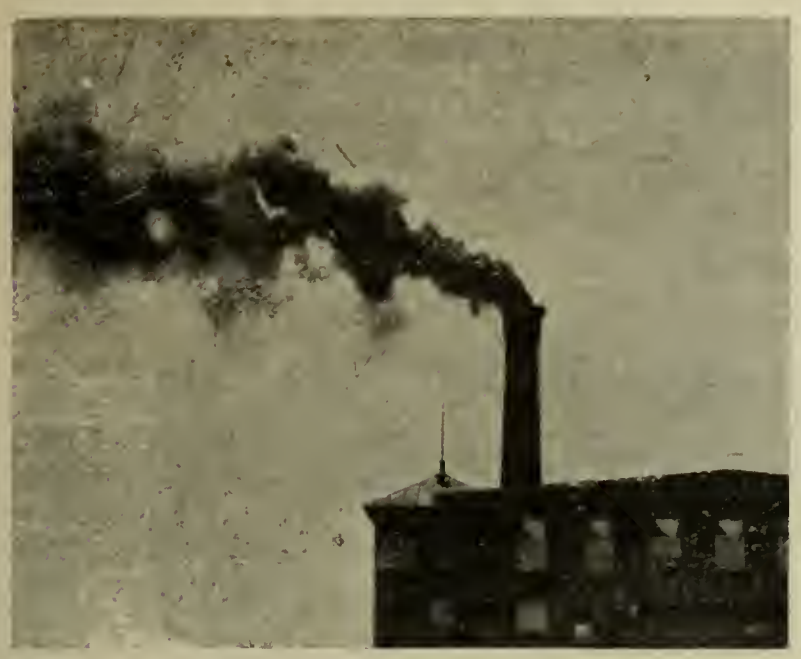
SEPT. 9TH, 1898—10.00 A.M.

JULY 22ND, 1898—10.10 A.M.

SEPT. 9TH, 1898—10.10 A.M.

JULY 22ND, 1898—10.20 A M.

SEPT. 9TH, 1898—10.20 A.M.



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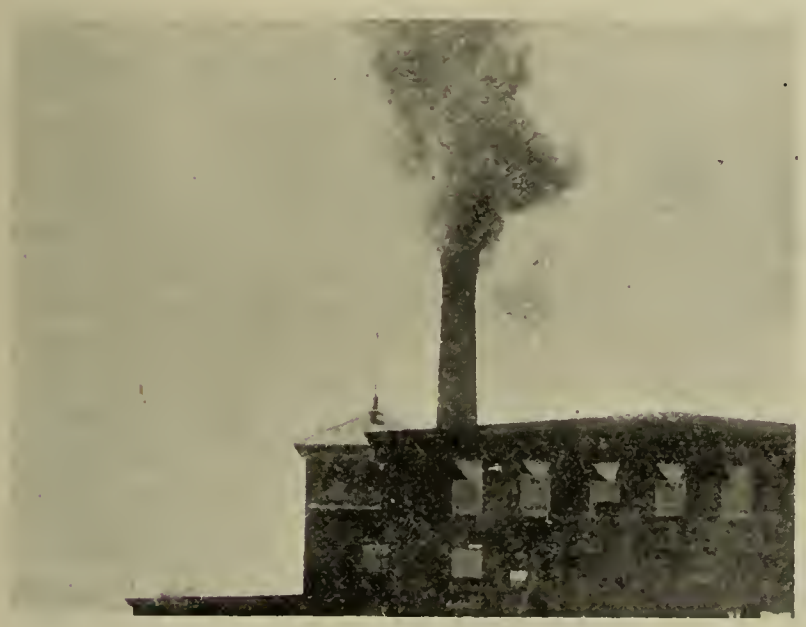

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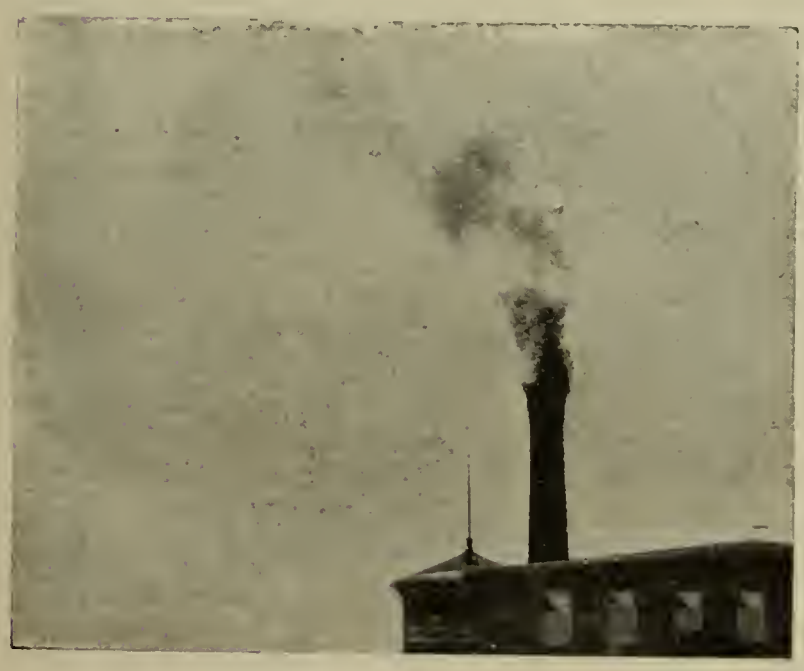


JULY 22ND, 1898—10.50 A M.

SEPT. 9TH. 1898—10.50 A.M.

pipe and extends the entire length of the magazine. Immediately beneath the conveyor pipe is located the wind box, having an opening beneath the hopper. At this point is connected the piping for the air supply, furnished at low pressure by a volume blower. The other end of the wind box opens into the air space between the magazine and outer casing. The upper edge of the magazine is surrounded by tuyeres, or air blocks, these being provided with openings for the discharge of air, inwardly and outwardly. Each stoker is driven independently by a small steam motor, located immediately in front and beneath the hopper. The motor has a simple reciprocating piston. Its piston rod carries a crosshead, which, by means of suitable connecting links, operates a rocker arm having a pawl mechanism, which in turn actuates the ratchet wheel attached to the conveyor shaft. The stoker is thus entirely self-contained and complete in itself, and consequently there is no danger of the driving and feeding mechanism (the only working parts) ever getting out of alignment. The rate of feeding coal is controlled by the speed of the motor, this being effected by the simple means of throttling the steam in the supply pipe to the motor. The shields covering the motor effectually protect the mechanism from dirt and dust. The coal is fed into the hopper, carried by the conveyor into the magazine, which it fills, "overflows" on both sides, and spreads upon the sides of the grates. The coal is fed slowly and continuously, and, approaching the fire in its upward course, it is slowly roasted and coked, and the gases released from it are taken up by the fresh air entering through the tuyeres, which explodes these gases and delivers the coal as coke on the grates above. The continuous feeding gives a breathing motion to this coke bed, thus keeping it open and free for the circulation of air. We call particular attention to the fact that every pound of coal fed into the hoppers passes

through this gas-making process, and there is no loss of coal through grates, by reason of the use of dead grates in the furnace, in place of open grate bars. The non-combustible is taken from the furnace in the shape of vitrified clinker. There is practically no soot, and with these results it is obvious that the combustion must be extraordinarily good.

"With our ability to feed the finest of slack coal we also handle lump coal, as any lump that can be fed into the hoppers will be crushed by the conveyor, there being provided a set of teeth, placed at the mouth of the conveyor, against which the coal is squeezed and broken." The American Stoker Company, whose Canadian office is at 54 Street Railway Chambers, Montreal, and is under the charge of W. E. Gower, is equipping quite a number of stokers in various parts of Canada and the United States.

ROPES AND ROPE DRIVING.*

BY L. H. KENYON, DUKINFIELD.

(Concluded from last issue).

Long Centres.—It is still a debatable question as to what distance unsupported ropes will convey power in a horizontal direction. Judging from the admirable manner in which ropes are working at 90 foot centres, the writer would have little hesitation in fixing them at a still greater distance. The main conditions are, well-sustained journals, plenty of room to permit the sag running clear of obstruction, and a liberal allowance for extra weight of rope—back driving, of course, always understood. The limit of endurance would be the same in any diameter of rope, as specific gravity and tensile strength are the same in proportion to the sectional area. For forward driving, much depends upon the diameter of the pulleys being sufficient to lift the outgoing from the incoming part of the rope.

Vertical Driving.—Pulleys fixed on the same vertical line may be successfully driven by putting on extra ropes, as the weight of the rope tends to fall out of the groove instead of into it. In this case, general efficiency depends greatly upon the elasticity of the rope.

Continuous Driving.—In America, Germany, and to a very slight extent in England, a system of rope driving known as the continuous rope, by which the power is transmitted through a single rope wound round the pulleys, is largely in use.

Cross Driving.—Up to this point, the question of rope driving has been treated as relating only to pulleys turning in the same direction. Ropes, however, may be as successfully applied to cross driving, with certain reservations, just as in the case of belts, gaining in frictional power, inasmuch as they cover more pulley surface, but at the expense of the ropes on account of continual contact in passing each other. To avoid the latter contingency as much as possible the pitch of the groove should be twice the usual distance, there being actually double the number of ropes at the crossing points. The ropes should also be crossed alternate ways in order that couplets may travel the same path in agreement and share alike the inevitable rubbing.

Rope and Spur Gearing Combined.—The difficulty of driving with ropes and spurs together, i. e., from one to the other either way, appears to be the result of back lashing, spurs being too rigid to yield to the more definite action of the ropes, which causes them to oscillate from side to side and often fly off the pulleys. It is a mistake to suppose that tightening will obviate these difficulties. This tends only to prevent reciprocal action, and we have known cases where teeth have been stripped as a result of tight ropes. Under such conditions, slack ropes are not only necessary but they should be fixed at different tensions in order to break the harmony without interfering with general efficiency. Each rope will then vibrate to a different rhythm, unless, which is not likely, the measure so arranges itself that unison of action is occasionally produced.

Rope Speed and Power.—Dismissing from our minds the vexed question of centrifugal force and the somewhat complex process of reasoning by which its effect upon high speed is supposed to be ascertained, it may be laid down as a safe rule to follow that a good cotton rope, 1¾-in. diameter, running at 1,000 feet per minute will comfortably transmit 10 h.p., and that this power increases or diminishes in the same ratio as the speed. You may therefore expect this size of rope running at 7,000 feet per minute to transmit 70 h.p. Some of our ropes are, however, transmitting 93 h.p. each at a speed of 7,040 feet per minute, and on one occasion, owing to an accident to its fellow, double this power was for a time transmitted through a single 1¾-in. rope. We understand that an engine is now in process of construction which is designed for a rope speed of 8,000 feet per minute, or rather over 90 miles per hour, and is to transmit 80 h. p. per rope. Even this may ere long be exceeded. At any rate, it appears that the speed limit has not yet been reached. Taking the above relative size, speed, and power for granted, it now only remains to calculate the power of other sizes from the sectional area, which may always be regarded as that of a circle. A rope 1½-in. diameter will then transmit 7.34 h.p. and 1¼-in. diameter 5.1 h.p. per 1,000 feet of speed.

Thin v. Thick Ropes.—Referring to the much contested question of the relative efficiency of thin and thick ropes, actual practice contradicts the oft advanced theory that ropes, say from 1-in. to 1¼-in. diameter, may be run with greater advantage than the thicker sizes, allowing the same relative diameter of pulleys. In the matter of durability thick ropes certainly take the lead, and this may be accounted for by the fact that their wearing surface is greater in proportion to the sectional area: e.g., we will suppose that 2-in. dia. rope is worn ⅛ of an inch all round. This would bring down its actual strength to 1¾-in. diameter only, or as 64 is to 49. The same chafing on a 1-in. rope would reduce its strength to ¾-in. dia. rope, or as 64 is to 36. It may also be mentioned that this fraying is far more pronounced on small than large ropes. Two-inch ropes however, look rather clumsy, are not easily handled in splicing, and necessitate large pulleys. This may to some extent account for 1⅝-in. and 1¾-in. becoming favorite sizes.

Guide Pulleys.—There is scarcely an angle or position of shaft to shaft from which power may not be transmitted by means of ropes and guide pulleys. Take, for instance, the intricate arrangement for driving a spinning mule or traveling crane. It must, however, be noted that every additional pulley beyond the necessary driver and driven takes from the durability of the rope, not only on account of extra friction but from strain and contortion. In consequence of this, the average life of a crane rope is scarcely a tithe that of the ordinary driving rope.

*A paper read before the Manchester Association of Engineers.

CANADIAN ENGINEERS.

The following extracts are from an address by T. P. Trowern before the C.A.S.E. No. 2, Sept. 9th, 1898:

The term stationary engineer is not the best word in the English language to be applied to a certain class of men; any person would think, if we were not particular about the names we are known by we will not be very particular about our work. The word "stationary" in our dictionary means "fixed, not moving, not advancing, not improving." An engineer is a man who constructs and manages an engine for manufacturers and motive power of all sorts, including naval and military defence. There are mining, canal, lake, civil and sanitary engineers, in fact, all sorts of machinery to be kept in motion and repaired by them. Our medical and surgical men should be classed engineers because they keep the machinery of our bodies in motion. Within the last few years we have had brought to our notice electric, gas, magnetic, wind, railway and aerial engineers, and a number of others may spring up when we are taken away. An engineer is a man who is generally understood to be very active in attending to his engine and machinery, keeping it in good order and clean; do a few repairs himself: not a stationary man to look at some boy do the work. I would, therefore, propose that our society be called the "Canadian Engineers' Society," and open our doors to all engineers, and have among ourselves examining committees or boards for each branch of free lectures, with addresses and remarks which may be of much use and edification to us all. Union is strength, power and force. As all animal bodies are machines, men and women included, we should be all physical engineers of ourselves, and a benefit to our neighbors; we should study our own mechanism and see what can be done to prevent sickness, promote health and long life and a happy one; drop off all useless habits and

regulate our diet and rest as we do the steam to the cylinders and in the boiler, by a good safety valve.

When I look at the words "stationary engineers," for myself and position, I find that it does not well apply to me, as I have every day to overlook in the Toronto Asylum for the Insane, 50 closets, 25 bath-tubs, 30 wash basins, drains and ventilators, 6 water tanks (40,000 gallons), pipes and taps, about 300 working every day; 14 heating boilers—hot water system; 4 steam boilers, 2 for cooking; the baking of meat and everything by steam for 800 people in 14 kettles, and two others for laundry work (about 8,500 pieces are cleaned every week), with six washing machines, six mangles, and ironing machines, both steam and gas; 50 electric bells, 16 telephones, batteries, electric light and gas pipes, chandeliers, a blacksmith shop for doing all repairs about the house and farm, and burn 1,700 tons of coal per year. You cannot call me "stationary" when in addition to this I look after four hydraulic elevators and 2,240 feet of railroad with ten cars.

Mr. Trowern also read the following poem:

THE LITTLE CANADIAN ENGINEER'S BIRTHDAY.

He has given up his cradle and his little worsted ball;
He has hidden all his dolls behind the door;
He must now have a rocking horse, and a spinning top of course,
For he isn't mamma's baby
Any more.

He has now cut off all his curls, for they're only fit for girls,
And left them in a heap upon the floor;
For he's five years old to-day, and laughs to hear his parents say,
He'll not be mamma's baby
Any more.

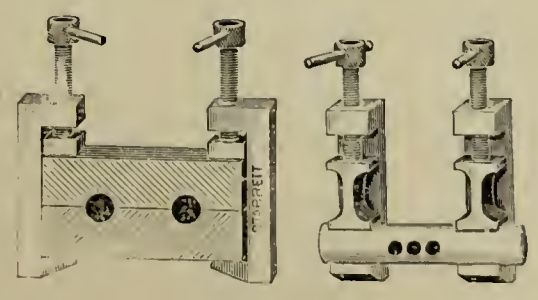
He has pockets in his pants like his older brother, Jack;
And he thinks he should have had them long before.
His boots are buttoned to the top; he jumps and will not stop,
Because he isn't mamma's baby
Any more.

He has heard his parents sigh, and has greatly wondered why,
They think he'll grow some day to be a man.
Now he's their darling little boy, then he'll be their pride and joy,
For he cannot be their baby
Any more.

When he's advanced in life and he thinks he'd love a wife,
His parents should direct him how to choose;
For he wants a happy home when his engine work is done;
And to be her darling boy
Ever more.

Yes, he'll find in her a mine,.for she's worth her weight in gold;
She will save and make the best of everything.
She will read and play and sing, and he'll help the music ring:
He's her darling happy boy
Ever more.

TOOL MAKERS' STEEL CLAMPS.

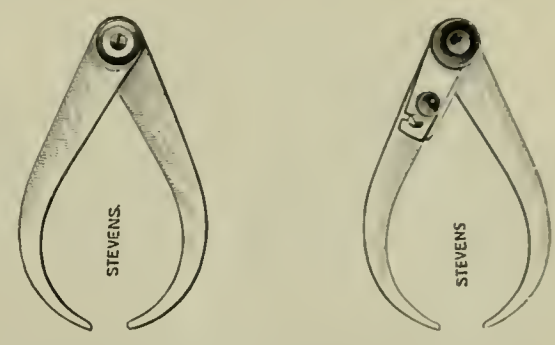


No. 160.

These clamps are made from drop forgings, nicely finished, case-hardened, and have take-up blocks to slip on and off end of screw, and are held to same in a novel manner. They will hold work square and parallel for laying out on surface plates, fitting or drilling, and the makers state that a round piece may be rigidly held in two of the clamps and drilled on an upright, central and parallel. They are put up and sold in pairs. With the small block in use, the capacity of the smaller clamp is a little over one inch, and that of the larger clamp two inches, and they are made only in two sizes, 1 inch and 2 inches, and a guarantee of their quality is the fact that they are made by the L. S. Starrett & Co., of Athol, Mass., and are put on the market by the Aikenhead Hardware Co., who report large sales and perfectly satisfied purchasers.

SHOP POINTERS.

In submitting "Shop Pointers and All-Steel Tools" to the mechanics of the country, the publishers, J. Stevens Arms & Tool Co., Chicopee Falls, Mass., fully realize the critical inspection to which it will be subjected. However, they invite inspection and criticism, for every tool they illustrated has the maker's approval and guarantee. They believe them to be mechanically perfect. The publishers solicit criticism and correspondence. If every mechanic into whose hands "Shop Pointers and All-Steel Tools" comes, will offer suggestions on tools, and give his ideas on using them, they will put this information into such form, they state, that they can give it to anyone who will write for it. A free interchange of ideas will help to make better mechanics; this means better wages. "All-Steel Tools," is our motto, to quote exactly. Whenever advisable, we harden our all-steel tools; in fact, no expense or care will be spared to keep our tools where they are now—at the front.



Man is fallible, and if through any oversight an imperfect tool should leave our factory, we will consider it a favor if the mechanic receiving it will return it to us, that we may make good the error. During the last year, where there has been chance for improvement, every tool and rifle manufactured by us has been remodeled; some have been discontinued. Everything now made by us is modern in every particular. We believe that our efforts in the course we are pursuing will be appreciated. We wish to work in closer sympathy with the mechanics, so they will feel there is one tool-making company that has their welfare in mind. This book is the only one from which tools should be ordered.

Chas. P. Fay, so well known as an inventor and designer of calipers, dividers and fine tools, has acquired the interest of his late father in the J. Stevens Arms & Tool Co., where he learned his trade and brought out his first calipers and dividers. The tool department is under his supervision. The Fay Ideal and Leader Calipers and Dividers are his latest patents in this line, while there are also ready, or in process of construction, several new tools which will fill long felt wants of mechanics. A few extracts from this little book, which will be sent free on receipt of a postcard to the publishers, are here given:

DEPRECIATION OF FIRST COST OF MACHINERY A YEAR.

	Depreciation.	Wear and Tear.	Total.
Engines	3 per cent.	3 per cent.	6 per cent.
Boilers	7 per cent.	3 per cent.	10 per cent.
Machines	5 per cent.	3 per cent.	8 per cent.
Gearing, etc....	3 per cent.	2½ per cent.	5½ per cent.
Bands & belts.		45 per cent.	45 per cent.

To Soften Cast Iron for Drilling.—Heat to a cherry-red, having it lie level in the fire. Then with tongs, put on a piece of brimstone, a little less in size than the hole is to be. This softens the iron entirely through. Let it lie in the fire until slightly cooled, when it is ready to drill.

To harden small tools or articles that are likely to warp in hardening, heat very carefully, and insert in a raw potato, then draw the temper as usual. A bar of hard soap is also good, but will not make the tool as hard as the potato will. In laying out work on planed surfaces of steel or iron use blue vitriol and water on the surface. This will copper-over the surface nicely, so that all lines will show plainly. If on oily surfaces, add a little oil of vitriol; this will eat the oil off and leave a nicely coppered surface.

RULES FOR CALCULATING SPEED.

The diameter of driven given to find its number of revolutions.

Rule.—Multiply the diameter of the driver by its number of revolutions and divide the product by the diameter of the driven. The quotient will be the number of revolutions of the driven.

The diameter and revolutions of the driver being given to find the diameter of the driven that shall make any number of revolutions.

Rule.—Multiply the diameter of the driver by its number of revolutions and divide the product by the number of required revolutions of the driven. The quotient will be its diameter.

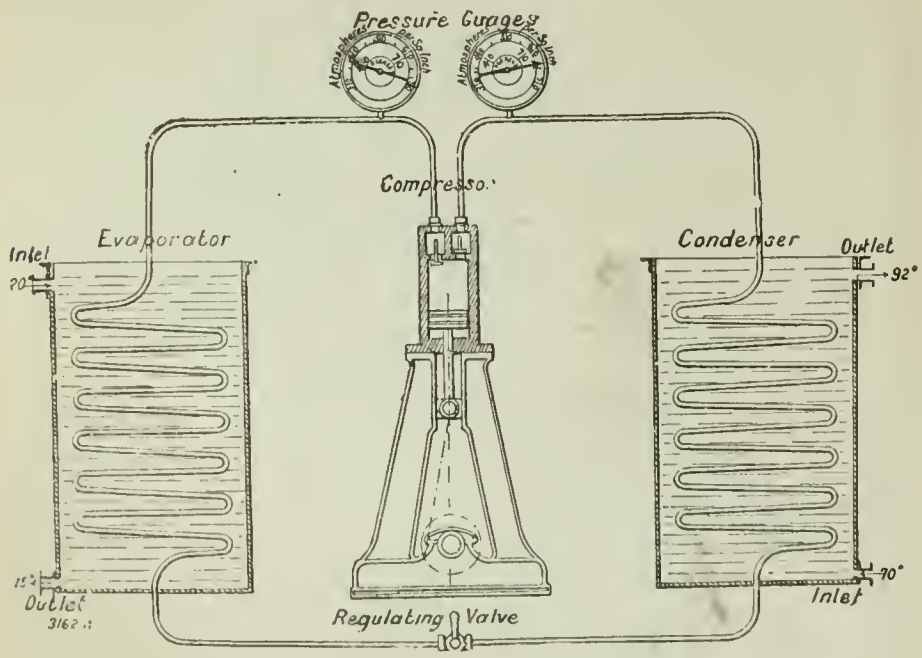
To ascertain the size of pulleys for given speeds.

Rule.—Multiply all the diameters of the drivers together and all the diameters of driven together; divide the drivers by the driven. Multiply the answer by the known revolutions of main shaft.

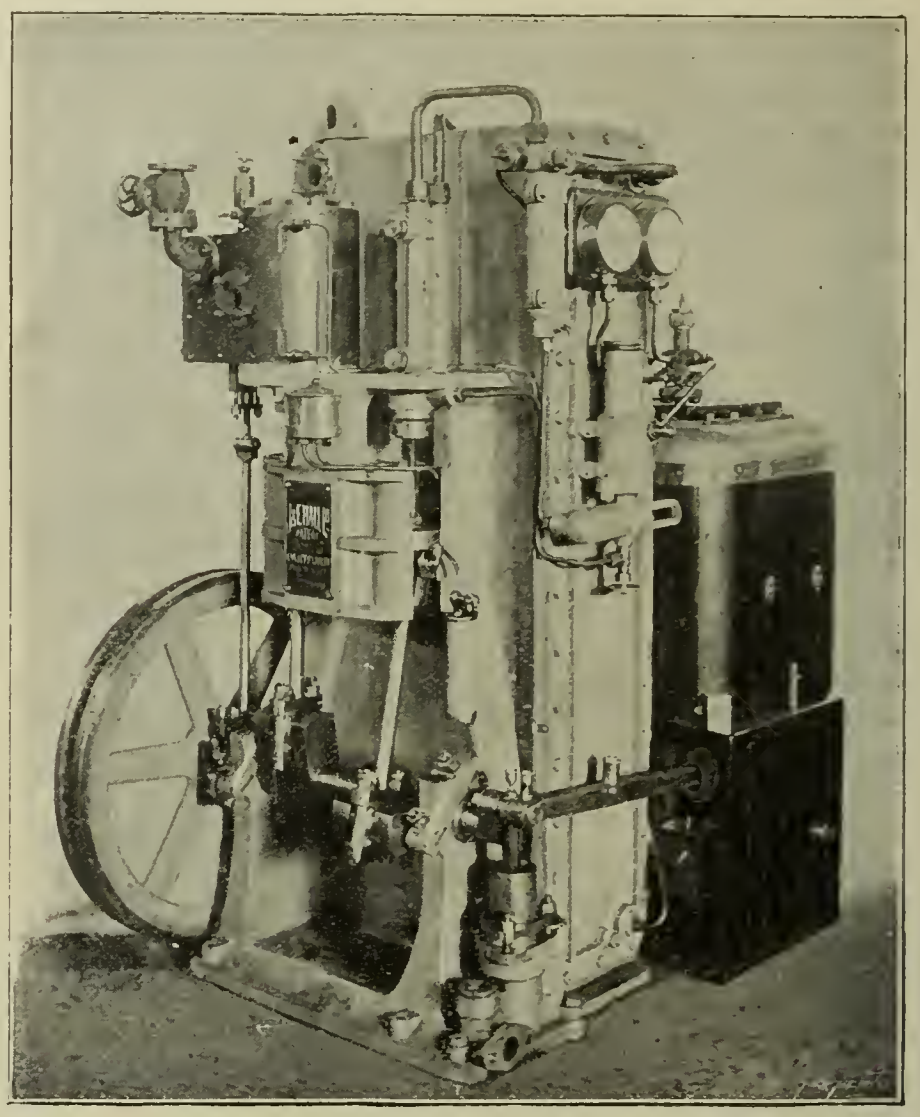
REFRIGERATION.

The Carbonic Anhydride Refrigerating machines, made by J. and E. Hall under their patents, consist of the following three parts: 1. The compressor (the only moving part), in which the gas drawn from the evaporator is compressed. 2. The condenser, consisting of coils, in which the compressed warm gas is cooled and liquefied by the action of cooling water. 3. The evaporator, consisting of coils, in which the liquid carbonic anhydride evaporates, producing any degree of temperature that may be required down to 80 degrees below freezing point. The charge of carbonic anhydride originally put into the machine is used over and over again, going progressively through the processes of compression, condensation, and evaporation. Thus a small quantity only is required to be added from time to time to replace any small losses, and for this purpose Carbonic Anhydride is sent in steel cylinders to any part of the world. The cost of the material is only a few pence per pound. The quantity required for a complete charge is very small, the cost of a charge for a 24-ton ice plant being only about $35. Carbonic Anhydride is stated by the manufacturers to be a non-poisonous gas.

The compressors for the large machines are bored out of solid steel forgings, to secure strength and soundness of the material, and to provide a perfect bore in which may work the



cup leathers with which the pistons are provided. Compressors of smaller machines are cast in a special bronze, which secures the two essentials of soundness and hardness. The gland is made gas-tight by means of two cupped leathers on the compressor-rod. Glycerine is forced into the space between these leathers at a pressure superior to the greatest pressure in the compressor, so that whatever leakage takes place at the gland is a leakage of glycerine either into the compressor or out into the atmosphere, and not a leakage of gas. What little leakage of glycerine takes place into the compressor is advantageous, inasmuch as it in the first place lubricates the compressor, and in the second place it fills up all clearances, thereby increasing the efficiency of the compressor. In order to replace the glycerine which leaks out of the glycerine lubricator, there is a small hand hydraulic pump, a few strokes of which are required to be made every four or five hours, as may be indicated by the position of the glycerine piston-rod.



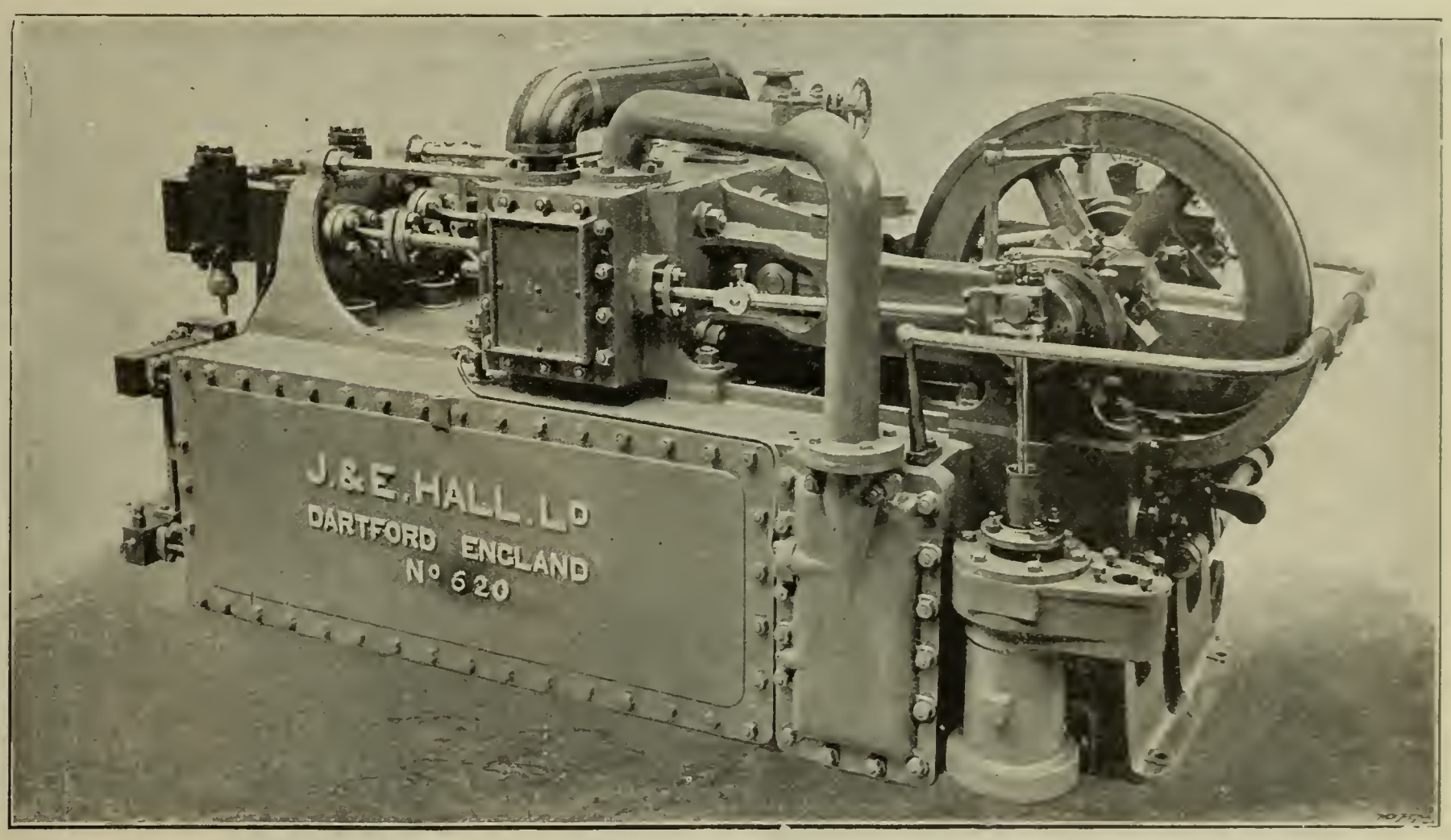
VERTICAL MARINE TYPE OF J. & E. HALL'S PATENT CARBONIC ANHYDRIDE REFRIGERATING MACHINES.

The condenser consists of coils of wrought-iron hydraulic pipe, usually of 13-16-in. bore, which are either placed in a tank and surrounded by water, or are arranged so that water trickles over them, forming the well-known atmospheric condenser. These coils are welded together into such length as to avoid altogether any joints inside the tank, where they would be inaccessible. The welding of these pipes is all done by the electrical method, which gives very reliable results. The condenser has, the makers state, one very important advantage of Carbonic Anhydride machines as is apparent, for as Carbonic Anhydride has no chemical action on copper, in the numerous cases where sea-water only is available for condensing purposes, that metal is used in the construction of the coils. The evaporator also consists of nests of wrought-iron hydraulic pipes welded up into long lengths, inside which the carbonic anhydride evaporates. The heat required for evaporation is usually obtained either from brine surrounding the pipes, as in cases where brine is used as the cooling medium, or else from air surrounding the pipes, as in cases where air is required to be cooled direct. Between the condenser and evaporator there is a regulating valve for adjusting the quantity of the liquid carbonic anhydride passing from the condenser.

As a refrigerating agent, liquefied carbonic acid is claimed to be second to none. Under atmospheric pressure it evaporates from the solid state at the particularly low temperature of 120 degs. F. below zero, or 152 degs. below the freezing point of water. In the refrigerating machine, however, it is caused to evaporate at only a few degrees below the temperature of the material which it is proposed to cool, the principle of the machine being exactly the same as that of machines using anhydrous ammonia on the compression system—viz., as water boils at 212 degs. F. under atmospheric pressure, and about 250 degs. F. at, say, 15 lbs. pressure, fire being usually the source of heat, so liquid carbonic acid boils at 30 degs. F.

at 35 atmospheres' pressure, and thus permits cold water to be the source from which the necessary heat to boil it is absorbed, exactly in the same manner as the heat of the fire is absorbed in boiling water. The compressor draws the gas from the evaporator and compresses it to the liquefying pressure, which is controlled within certain limits by the temperature of the cooling water. The heat due to compression is absorbed by the cooling water in the condenser, the gas circulating within the condenser coils and becoming liquefied by the time it reaches the lower extremity of these coils.

By regulating the pressure in the evaporator, the liquid is caused to boil throughout the coils of the evaporator, which act in the same manner as the heating surface in a steam boiler, and the temperature or boiling point of the liquid carbonic acid adjusts itself to that of the source of heat which is causing it to boil, whether it be water at 70 degs. to be reduced to 40 degs., or brine to be maintained at + 10 degs. F. or — 10 degs. F. The surfaces of the evaporator coils are so proportioned that all the liquid which enters at the lower end of the coil is evaporated by the time it reaches the top end, and thus the maximum efficiency is obtained. The compressor then draws in only gas, and compresses it up again to the pressure necessary to liquefy it, and delivers it warm to the condensing coils to continue the cycle of operation. These machines are extensively used on board ship, in cold storage warehouses, breweries, ice factories, etc., not only in Great Britain but throughout the British colonies and the world generally.



HORIZONTAL DUPLEX TYPE OF J. & E. HALL'S PATENT CARBONIC ANHYDRIDE REFRIGERATING MACHINES.

THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

The eighth annual convention of the Association of Railway Superintendents of Bridges and Buildings was held at Richmond, Va., from October 18 to 20, 1898. The programme included many features of amusement and pleasure besides the reports of the various committees.

The committee on the subject, "Pile Rings and Method of Protecting Pile Heads in Driving," presented the following report: First. We find that the best way to protect the pile head is to use a 1x3-inch ring, made out of the best iron that can be obtained at the place where used. We recommend, where a railroad company have a steam hammer in its shops, that they make their pile rings out of hammered iron from old car axles. The cost of a 1x3—14-inch diameter ring is $1.75, while the same size ring made out of best bar iron costs $2. A pile ring made out of hammered iron will last to drive 75 oak piles and at least 300 cedar piles. The rings made out of best bar iron usually last to drive 50 oak piles and 200 cedar piles; in fact, one of your committee had 50 pile rings made out of old car axles four years ago, and since that time has driven 250 oak piles and 6,000 cedar piles without any renewal of pile rings. A pile driver should carry on the tool car 60 pile rings, 10 pile rings 15—30—14 inch., 10—13½ inch., and 10—13 inch. in diameter. The 14-inch diameter are the ones most used, 14-inch being the width of caps used by most roads. It is not necessary to have the pile head larger in diameter than the cap is wide.

Second. In fitting the pile ring, the pile should be neatly sawed off square; the pile should be neatly chamfered down at least 5 inches from the end, so the ring will just catch on and let the pile hammer do the rest. This is a little hard on rings but in this way you are sure to get a good fit of the ring and the pile head is best protected.

The face of the pile hammer should be concaved to the depth of 1½ inches in the centre, and run out to nothing 2 inches from outside of the hammer; this will drive the fibre of the wood down slightly over the edge of the ring and make a neat fit of the hammer, and if the piles are kept exactly under the hammer, there is very little danger in fracturing the pile. The best weight of a pile hammer is 3,300 pounds. The height of the blow should not exceed 12 feet in driving cedar piles, or 20 feet in driving oak piles. It will be found that short, quick blows will drive the pile as quick as long blows, and are less liable to injure the pile. The pile should be neatly prepared before driving it; the knots should be neatly trimmed off, and the pile sharpened to a 4-inch square point for hard driving, the point to be made as near straight with the pile as possible. Piles should never be over-driven. When a pile does not go over 1 inch at a fall of 10 feet with a 3,300-pound hammer, the blow should be shortened to 6 feet, and the pile carefully driven until it stops going or does not go over ¼-inch at a blow. The driving of piles for railway traffic, and for all kinds of structures, requires a great amount of judgment to do good work.

The report of the Committee on the care of iron bridges after erection, including the best method of protecting them from salt water drippings from refrigerator cars, stated that the successful maintenance of a bridge will depend upon the character of the bridge to be maintained—a bridge which has been properly designed requiring less attention than one which has been bungled. By "less attention" it is not to be inferred that

neglect is meant. If the bridge was first class in the first place, and by "first-class" is meant one which has been designed by an engineer thoroughly familiar with this class of work, the material of which is of the best quality obtainable, and an assurance of that quality being evidenced by tests and inspection, the shop work on which has been done in a shop thoroughly equipped to do good work and a competent inspector being present to see that this work is done, and finally one that has been erected without abuse, and left in perfect condition, without a loose nut or rivet and which after having been thoroughly cleaned of all dirt and loose scale, has been painted with at least three coats of the best paint obtainable, then the proper care of this bridge means merely to keep it in as good condition as it was the day it was put up. This seems simple enough on its face, but unfortunately those who have charge of the maintenance of the bridge are so relieved after they get possession of a first-class structure, that they turn their attention mainly to other bridges and are inclined to allow the new one to take care of itself without any special attention for a number of years. Even the inspector whose duty it is to go from bridge to bridge regularly passes over this new structure with the thought, "it was just put up a short time ago and there can be nothing the matter with it;" in fact the new bridges are too often almost neglected on account of the attention which must be given to those which are bad. The care of new plate girder bridges of modern design involves less actual labor than any other class of bridge work, but there are many plate girders which are of defective construction carrying trains to-day. Their webs may be ¼-inch thick, rolled in short lengths and spliced together by an insufficient number of rivets and not sufficiently stiffened against buckling. Their flanges may be composed of light flange angles to which are riveted heavy cover plates, and the transferring of the strain of the flange angles through the webs is done by rivets made ⅝-inch in diameter and spaced at such a distance apart as to subject them to the danger of shearing off. The care of such a bridge is a serious question, as there is no good way to strengthen it. It should be trestled and renewed as soon as possible. In the above but little has been said concerning the painting of a bridge. The kind of paint to be used is a matter which many engineers are not fully agreed upon, and has been a subject of discussion at previous meetings of this society. The committee therefore consider that they are not called upon to enter into this question further than to say that no matter what kind of paint is used, no matter what is paid for this paint, and no matter how well the paint is applied to the surface, if that surface has not been thoroughly cleaned of all rust, scale, dirt, and grease before the paint is applied, it will not give satisfaction. The question of best method of protecting bridges from injury by salt water drippings is one upon which little can be said. That this dripping is very injurious to metal none will question except perhaps the owners of refrigerator cars. Some little interest is being taken in this subject by the officials in charge of track and bridges, but little or none by those in charge of the transportation departments, and while the remedy should be applied to the cars instead of the bridges there will undoubtedly be opposition to this method by the car owners, who will probably be very slow to provide their cars with the necessary protection unless forced to do so by the railroad companies' united action. Voluminous reports accompanied by diagrams were also presented on the cost and manner of putting in pipe culverts, on round house smoke jacks and ventilation on heat floors for shops and round houses.

LITERARY NOTES.

Soft Coal Burning is a most interesting discussion of the subject of boiler setting and construction, and the benefits of careful firing. The author is C. M. Higginson, and it has already reached its fifth edition. There are twenty pages of closely printed matter, all of which is of value to the steam producer.

Mechanical Draft for Steam Boilers, by Walter B. Snow, being an abstract of a lecture before Sibley College, Cornell University, has been reprinted from The Sibley Journal of Engineering, and we have been favored by the author with a copy. We will return to the subject at a later date when we can devote more space to it.

We have received the Engineers' Year Book, published by the Society of Engineers of the University of Minnesota, which comprises about one hundred pages and contains a number of instructive articles, among which one of the most instructive is that of the Reclamation of Wet Land, by W. R. Hoag, C.E.

Printers' Ink, New York, has gotten out a 70 page pamphlet neatly bound in rough green paper, which sets forth the great merits of this famous advertising weekly. The outside cover bears in red letters the statement: "American advertising is the best in the whole world, and Printers' Ink made it what it is."

The Whiting Foundry Equipment Co., Hainey, Ill., U.S., has sent us a copy of the second edition of their general catalogue. The firm also issues special catalogues of cranes, cupolas, air hoists, Avery holding machines, etc.

We have on our table a copy of Shop Pointers and "All-Steel" Tools, which is a neat and comprehensive catalogue, published by the J. Stevens Arms & Tool Co., Chicopee Falls, Mass., U.S.

The Ores of Nova Scotia, by E. Gilpin, jr., is a description of the gold, lead and copper deposits of Nova Scotia; it has not been written from a technical or scientific point of view, but intended to convey in a practical manner a fair idea of their extent, value and adaptability for profitable mining. The lead and copper deposits of Nova Scotia are as yet undeveloped, although they are wide spread and promising. The gold deposits, alluring from their display of free gold, have received locally much attention. This attention, as may be gathered from his brief remarks, has not been for many years of an encouraging nature, as it was an affection of the hope of immediate returns, and not an endeavor to reduce gold mining to its true position, a commercial enterprise. Until a few years ago the local capitalist wanted something rich, a fortune without labor, extracted from a golden bunch of quartz or from the pocket of an innocent investor. Now, however, the fact is recognized that gold mining is a business, not necessarily a roseate speculation; and veins and deposits are being profitably worked, on business principles, which, a few years ago, would have been spurned. Since this principle has been accepted it is safe to say that the gold interests of the Province, Mr. Gilpin states, have an assured future.

A copy of the Entropy-Temperature Analysis of Steam Engine Efficiencies, with a blank diagram arranged for easy application to any concrete case, prepared by Sidney E. Reeve, M.E., adjunct professor of steam engineering at the Worcester Polytechnic Institute, has reached us. The original discoverer of the entropy method to steam engine analysis was Prof. Willard Gibbs, of Yale University. Since then many engineers of prominence have subscribed to and used the method. The immediate progenitor of this present form of diagram was a similar one projected by Professor Boulvin, of Ghent University, a description of which will be found in Engineering (London) for January 3, 1896. This diagram not appearing to the author to be either convenient or exact for general use, it was modified by him to the form herein offered to the profession for adoption or criticism. The nomenclature and notation is in accordance with Professor Ewing's "Steam Engine and Other Heat Engines."

The Practical Tool Maker and Designer is a treatise upon the designing of tools and fixtures for machine tools and metal working machinery. It comprises modern examples of machines with fundamental designs for tools for the actual production of the work; together with special reference to a set of tools for machining the various parts of a bicycle. The author is Herbert S. Wilson, M.E. There are 189 illustrations, and the publishers are Henry Carey Baird & Co., Philadelphia.

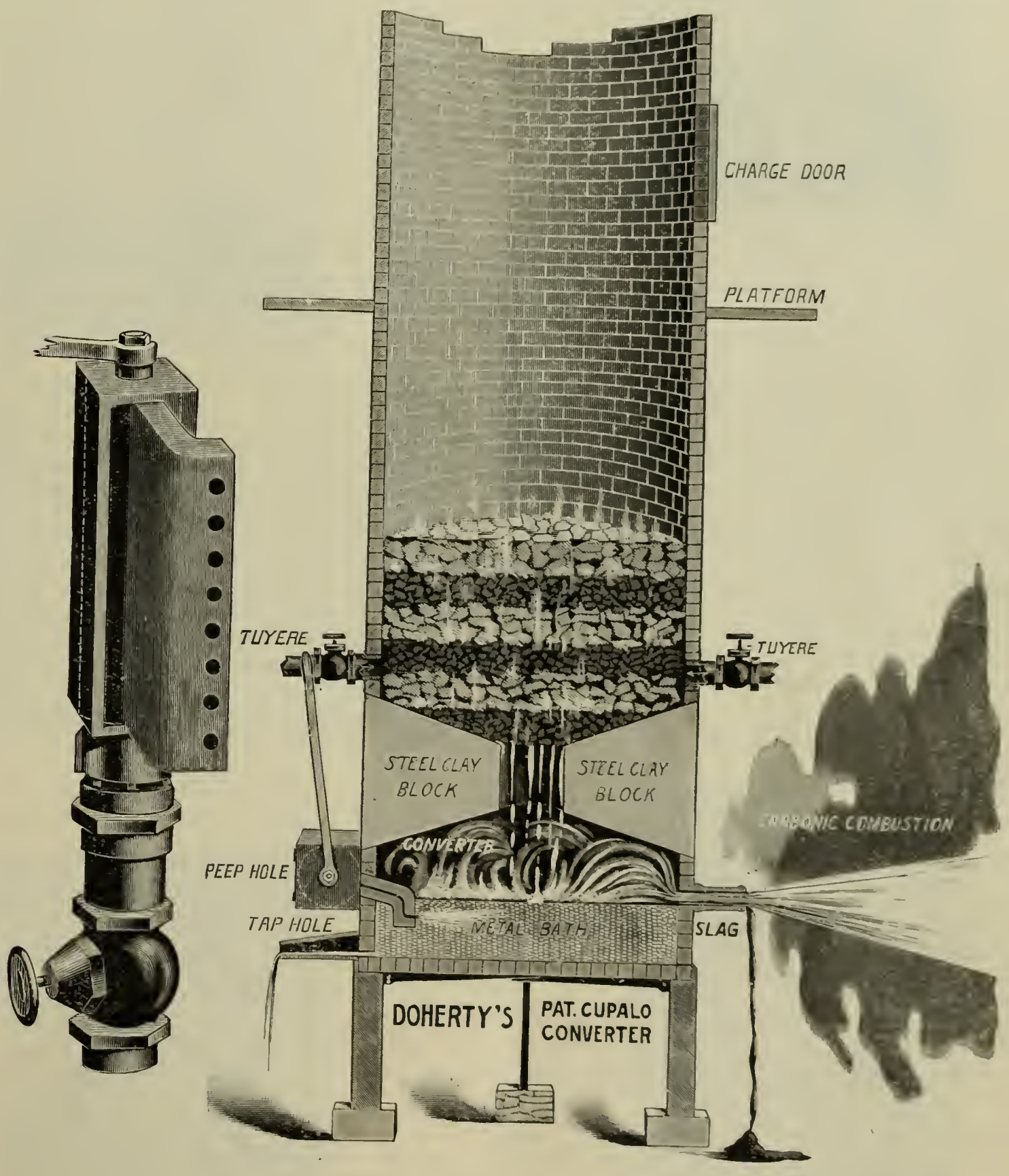
The Department of Colonization and Mines of the Province of Quebec has issued a special report by J. Obalski, mining engineer for the government, on the gold deposits of the province. It is entitled, "Or dans la Province de Quebec, Canada," and comprises some hundred pages of valuable statistics and general information.

W. A. Morehouse & Co., publishers of The Sherbrooke Examiner, deserve great credit for the artistic style in which they have produced "Sherbrooke Illustrated," a handsomely illustrated history and description of the enterprising capital of the Eastern Townships. The book contains over 100 pages,

and more than that number of half-tone engravings of the public buildings, colleges, schools, churches and other institutions of the city, with portraits of leading citizens and samples of the picturesque scenery of the Magog river, which gives to Sherbrooke so much of its beauty as well as its great commercial advantages in water power.

A DEPARTURE IN FOUNDRY PRACTICE.

This recent invention of Thos. Doherty, Sarnia, Ont., consists essentially of a cupola and pneumatic converter combined in one. An ordinary cupola is divided by refractory fire bricks so arranged as to form a double bottom or partition above where the pig and scrap iron is charged in the usual manner, as shown in cut. The metal, as it becomes melted, falls down through an opening into the converter chamber where it accumulates and forms what is known as a bath, upon which compressed air is applied, and it is claimed by the inventor, converts the molten metal into any quality of steel desired, by the operation of a valve in the blast pipe. The reaction produced is similar to that of all the other pneumatic processes and produces intense heat, burning out the silicon and carbon and carrying off the slag automatically through the opening at the side as shown. In other words the raw material is charged in above, melted, converted into steel and tapped out below by one operation. This process is more especially adapted to making steel machinery castings at a low price. The difficulty heretofore, in the general adoption of steel castings, has been the extra cost. The process is being generally patented on this continent and in Europe.



A Departure in Foundry Practice.

CANADIAN SOCIETY OF CIVIL ENGINEERS

The first meeting of this society for the winter season was held at the society's rooms, Montreal, on Thursday evening, 13th October, P. W. St. George in the chair. There was a very large attendance, and the fortnightly meetings give promise of being very interesting.

After routine matters had been disposed of the secretary announced that a book had been opened in which to record the names of members seeking employment, it being the desire of members generally to assist those temporarily out of employment by giving them information of firms who might need their services. Several applications for membership in the society were recorded.

The following donations to the library were received: "Modern Methods of Sewage Disposal," from C. A. Biggar; "Surveying Instruments" and "Mathematical Drawing Instruments," from W. Ford Stanley; Report of the Hydraulic Engineer of Queensland on the Queensland Water Supply for 1807, from J. B. Henderson; "American Cements," from Uriah Cummings, of Akron, Ohio; "Centrifugal Pumps, Tur-

bines and Water Motors," from E. J. Boswell; photographs and pictures from J. W. Heckman, and a box containing about 100 volumes from John Kennedy.

The paper of the evening was by Prof. John T. Nicholson, of McGill University, on "Riveted Joints," which was not concluded, but is to be taken up again at the next meeting.

DR. JAMES WALLACE WALKER.

Dr. James Wallace Walker, M.A., Ph.D., the professor chosen for the new McDonald chair of organic chemistry in McGill University, Montreal, comes to McGill with a most brilliant record from the greatest teaching universities in England and on the continent of Europe. Prof. Walker is strongly recommended by Dr. Welhelm Ostwald, Ph. D., professor of Physical Chemistry in the University of Leipsic, one of the greatest of the world's great chemists. Dr. Walker was educated at the University of St. Andrews, Scotland, taking M.A. in 1889, as was stated in last issue of The Canadian Engineer, and after a short time spent in teaching mathematics at St. Andrews, he was appointed lecture assistant in chemistry at that university. In 1892 he entered the University of Leipsic and was shortly afterwards elected to one of the 1851 Exhibition Scholarships, holding it for three years, and received the degree of Ph. D. in 1896. In 1896 he was appointed lecturer in organic chemistry under Professor Ramsay, in University College, London, and was in 1897 also appointed examiner in chemistry for the Arts, Science and Medical degrees at the University of St. Andrews.

R. B. OWENS, E.E.

R. B. Owens, E. E., who has just been appointed to the W. C. McDonald professorship Electric Engineering at McGill University, is a native of Maryland, U. S., where his family has lived for generations, and where its members have held high positions of public trust. He was educated in Johns-Hopkins and Columbia Universities, obtaining the degree of E.E. at the latter. Prof. Owens resigned the charge of the Electrical and Steam Engineering Departments of Nebraska University to accept his present position at McGill. Among his most recent successes is the planning of the new engineering building for Nebraska University, which has been opened this month. At the Columbian Exhibition in Chicago Prof. Owens was a member of the jury in the department of electricity and chairman of the Electrical Committee, and as we stated in last issue of The Canadian Engineer was director of the Bureaus of Electricity and Machinery at the Trans-Mississippi Exposition at Omaha. He is a member of the Western Society of Engineers, the American Society of Mechanical Engineers, and the Council of the Society for the Promotion of Engineering Education, and vice-president of the American Institute of electrical engineers.

ERNEST RUTHERFORD, B.A., M.A., B.SC., OF TRINITY COLLEGE, CAMBRIDGE.

Ernest Rutherford, B.A., M.A., B. Sc., the professor of physics in McGill University, comes from Trinity College, Cambridge, and brings with him eulogistic testimonials from the faculty there, including a flattering recommendation from Dr. J. J. Thomson, M.A., Sc.D., F.R.S., professor of physics in Cambridge University. Prof. Rutherford, although already eminent in his profession, is a young man, having taken his first degree of Bachelor of Arts in the University of New Zealand in 1892, as we stated somewhat more fully in the October number of The Canadian Engineer, when we mentioned a few of the subjects in which Mr. Rutherford has made special research. He was made Master of Arts in the next year and Bachelor of Science in the year following at the same university. Coming to England he entered Trinity College, Cambridge, where he obtained the degree of Bachelor of Arts.

E. G. COKER, B Sc E

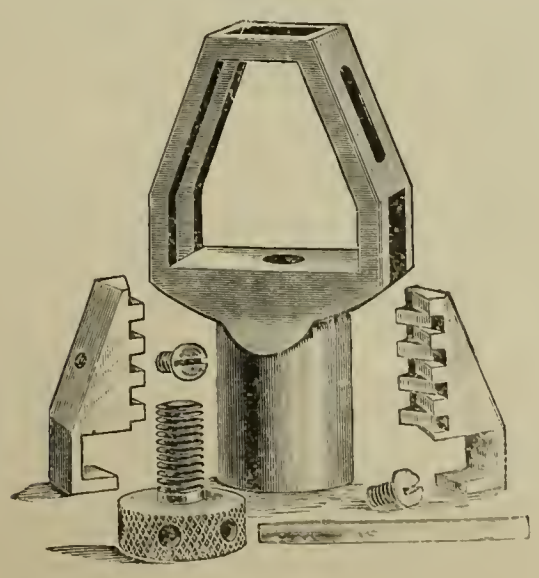
E. G. Coker was born in 1869, in Wolverton, and in 1883 entered the engineering shops of the London & Northwestern Ry., England, as a pupil, and served two years in the fitting, turning erecting and pattern makers' shops, and afterwards spent two years in the drawing office engaged in the design of railway plant and machinery. In 1887 he entered as a student of engi-

neering at the Royal College of Science, London, spending three years in the various laboratories of the college, passing out with a first-class associateship in mathematics and engineering. During period of training at Royal College of Science he gained the senior Whitworth exhibition for the year 1889, and in the next year the second Whitworth scholarship for proficiency in engineering science, these scholarships being open to all British subjects. After a short period in the works Mr. Coker entered the civil engineering course at Edinburgh University, being principally engaged in research work, passing out with the degree of Bachelor of Science in Engineering. After a year spent in engineering work he entered Peterhouse, Cambridge, and became a candidate for the Engineering Tripos, in both parts of which he was placed in first class, with special distinction being awarded in the subjects of "Theory of Structures and Strength of Materials" and "Heat Engines and Dynamics of Machines," being the only candidate who has up to now obtained these distinctions. During college vacations he spent the summer months in various works gaining experience in testing materials, constructive work and the like. Mr. Coker was elected (1895) a scholar of Peterhouse, and recently (1897) elected a member of the Institute of Mechanical Engineers. He has written papers on "The Tensional Strength of Solid and Hollow Shafting," and "On the Endurance of Steel Bars Subjected to Repetitions of Tensional Stress," published in the Proceedings of the Institute of Civil Engineers. He has devoted much attention to the design of instruments for measuring tensional strains, the results of which were embodied in a paper read before the Bristol meeting of the British Association in September last. Mr. Coker has just resigned the post of assistant examiner of patents in Her Majesty's patent office, London, to take up the duties of assistant professor of Civil Engineering at McGill.

FIRES OF THE MONTH.

Oct. 9th. Ott's tannery, Brantford, Ont.; loss on building, $2,000; contents, $1,000.——Oct. 13th. A small fire occurred in the Guelph, Ont., Linseed Oil Works.——Oct. 15th. Woodworking factory of Jos. Gosselin, Levis, Que.; loss about $25,000.——Oct. 17th. The Canada Eastern Railway Co.'s round house at Gibson, N. B.; six locomotives were destroyed. ——Oct. 19th. The Canadian Pacific Railway round house at Teeswater, Ont.; one locomotive was destroyed.——Oct. 26th. A. Thiboulot's carriage shop, Levis, Que.; loss about $15,000. ——Oct. 26th. W. H. Tighe's. evaporator, Chatham, Ont.; remaining building destroyed; loss $1,000.——Oct. 26th. The Royal City Planing Mill Co.'s mill known as Hastings mill, Vancouver, B.C., burned, with damages $200,000, and $83,000 insurance.

THE NATIONAL DRILL CHUCK.



The following claims for the National Drill Chuck are made: 1. That the grip to hold a drill is unequaled by any chuck upon the market. 2. The construction is so simple that any person can put it together in one minute. 3. The simplicity of construction and arrangement of parts causes the least wear, making it the most durable. 4. It is the only chuck ever made that all parts are exposed to view, so that any irregularity can be seen at once. 5. It can be thoroughly cleaned in one-fourth the time of any other chuck. 6. All unnecessary material is removed, leaving the strength where required, and making it from one-third to one-half lighter than any other chuck made. 7. The only chuck that is easily cleaned, being so open that the dirt will not stay in, and can be blown or brushed out without removing the parts. 8. A chuck that is perfectly balanced and made in all sizes—large and small. 9. The only chuck that is strong and powerful, equally adapted for either light, swift or heavy work. 10. The only chuck made that is adapted for heavy work having tapering body, with jaws projecting, so when using small drills, it will not cast a shadow or interfere in seeing your work. 11. The only chuck made that by being perfectly balanced, and small at lower end, will do the work of two other chucks, thereby saving the expense of one. 12. The easiest chuck to repair, the least liable to get out of order, making it the cheapest to buy. 13. The only chuck made with an unfinished body for blacksmithing and carriage work, making it stronger, cheaper and equally effective for use. The National Drill Chuck is made with finished and unfinished bodies, the inside workings of both being the same. The body of the finished is polished, while that of the unfinished is left with a black, smooth surface as forged. It is made in seven sizes in capacities ranging from 0 to 2 inch. Further information can be obtained from Aikenhead Hardware Co., Toronto.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interes to the metal trades from Great Britain during September and the nine months ending September, 1897, 1898 :—

	Month of September.		Nine months ending September.	
	1897.	1898.	1897.	1898.
Hardware	£7,041	£3,453	£50,672	£20,003
Cutlery	..	3,847	..	40,251
Pig iron	1,240	273	5,298	8,405
Bar, etc.	977	741	7,572	8,300
Railroad	171	2,147	38,893	25,154
Hoops, sheets, etc.	13,792	8,169	55 954	44,811
Galvanized sheets	7,346	4,445	35,547	44,252
Tin plates	30,073	5,667	132 840	104,039
Cast, wrought, etc., iron	3,887	4,041	25,957	24,457
Old (for re-manufacture)	1,937	..	5,191	3,754
Steel	6,258	4,282	41,061	39,734
Lead	5,170	4,339	19,062	24,665
Tin, unwrought	2,403	537	13,814	13,680
Alkali	5,808	4,210	26,082	32,035
Cement	3,757	2,934	15,611	17,927

WHO INTRODUCED THE EXPANSION CYLINDERS.

Editor CANADIAN ENGINEER.

Sir,—Touching the discussion that has been going on in The Scientific American and American Machinist as to who was the inventor of the second and third expansion cylinders in steam engines, Robt. W. Rule, Aylmer, Ont., adds a valuable statement. He says that in 1848 he was called out at St. John, N.B., to repair a boat called the "Reindeer," which ran between St. John and Fredericton. This steamer was fitted with a second expansion cylinder of the Wolff patent. Mr. Rule is a trustworthy machinist, and his statements could easily be verified at St. John. The old gentleman has many reminiscences of the famous Boulton & Watt "Soho" works near Birmingham, England, where he served his apprenticeship, 1840-6.

B.

CORRECTION.

In presenting in our last issue a synopsis of the paper "Remarks on the Systems of Refuse Disposal in Various European Cities," read by Thos. Macfarlane, chief analyst for the Dominion Government, before the American Public Health Association, a typographical error was made in describing the system in use in Bremen, Germany, which is that of using "Moss-Litter" as a deodorizer. This is also used in a hotel at Caledonia Springs, Ont., which Mr. Macfarlane mentions.

Industrial Notes.

J. H. Allan, Milton, Ont., is to establish a creamery in Carleton Place, Ont.

The St. Thomas, Ont., Brass Company has equipped a foundry at a cost of $10,000.

Lindsay, Ont., is lending $20,000 to Sylvester Bros., foundrymen, to extend their business.

Clark Bros., Toronto, have the contract for building the Normal School, London, Ont.

An iron bridge has been erected at Glendale, C. B., by R. Musgrave & Son, North Sydney.

The Geo. White & Sons Co., Ltd., London, Ont., is building a new boiler shop, 70x70 feet.

The Guelph Paving Co. will get a contract from Brockville, Ont., for about $60,000 of pavement.

The capital of the Page Wire Fence Co., of Ontario, Ltd., has been increased from $40,000 to $100,000.

Ker & Harcourt, spool and bobbin manufacturers, have removed their plant from Walkerton to Parry Sound, Ont.

Wm. Willoughby, brick and tile manufacturer, Carleton Place, Ont., is closing up business, and will dispose of his plant.

It is proposed to establish a match factory in Winnipeg, for which the city council is asked to give a bonus of $15,000.

Krug Bros. & Co., Chesley, Ont., have ordered an 80 h.p. boiler and engine from the Robb Engineering Co., Amherst, N.S.

Brantford, Ont., has granted the Chalcraft Screw Co. and the Nott Bicycle Company exemption from taxation for ten years.

Willis Chipman, C. E., has reported that necessary improvements to the Sherbrooke, Que., waterworks will cost about $62,000.

Arthur Hilyard and Jules Spiro, New York, are negotiating with people in St. John, N. B., for the erection of a pulp mill at Navy Island.

Waterloo, Ont., will submit a bylaw to be voted on Nov. 21st to raise $50,000 for the purchase of the waterworks and to complete the system.

Bannerman & Findlater, boiler makers, Ottawa, have just shipped two 80 h.p. boilers to the mills of McLaurin & McLaren at East Templeton, Que.

H. Sewrey, G. H. Sewrey and W. Johnson are building a foundry in Barrie, Ont. It will be a one-story frame building, 120 feet long and 36 feet wide.

Thurso, Que., has decided to have a waterworks system. The Stadacona Power Co., Montreal, has the contract for installing it. The price is $14,000.

The Guelph, Ont., Linseed Oil Co. is now in operation and is producing raw and boiled oil from Canadian flax seed. Fourteen men are employed at present.

The town of Dundas, Ont., is applying to the Legislature for power to grant to John Bertram & Sons, the famous machine tool builders, a bonus of $12,000.

Berlin, Ont., took possession of the waterworks on Oct. 8th, which have hitherto been operated by a company. The price paid by the town was $102,000.

E. G. Barrow, city engineer, Hamilton, Ont., proposes a new 30-inch main from the Beach pumping station to the city at a cost of between $161,152 and $181,815.

H. McLean, of Calgary, in company with Wanless & Carsons, has purchased the Calgary flouring mill, from the Manitoba Grain Co., and will refit it with new machinery.

The Granby, Que., Iron Works, owned by G. F. Payne, and comprising foundry, iron works and machine shops, have been disposed of to S. S. Dabble, Sandy Hill, N.Y.

The new drill-shed at Kingston, Ont., will be of stone, 230 by 115 feet, and will be erected in the old Artillery Park. Work will be begun on it at once. The cost will be $15,000.

W. G. Nott, J. T. Ham and J. H. Ham, M. A. Nott and C. W. Hoffmann, Brantford, Ont., have received an Ontario charter as The W. G. Nott Bicycle Company of Brantford, Ltd.

The statement of the affairs of the British Columbia Iron Works, Vancouver, B.C., published this month, shows losses of $126,000; the creditors have agreed to accept 50 cents on the dollar.

The Toronto Terra Cotta Co.'s works on the C.P.R., near Milton, Ont., which have been closed for some years, are being put into working order and will resume operations shortly on a large scale.

Tenders are called for a steel arch bridge at the Gorge, Victoria Arm, B.C., by the chief commissioner of lands and works, British Columbia, and will be received up to the 30th of this month.

The Paris Electro-Plating Co., Paris Station, Ont., has been compelled by growing business to build a moulding shop, 32x50 feet, and the company is now prepared to turn out fine gray iron castings.

The recent disastrous fires in Levis, Que., have opened the eyes of the town corporation to the necessity of a proper waterworks system, and at its last meeting it decided to construct one and have it in working order by Oct. 1, 1899.

City Engineer Barrow, of Hamilton, Ont., is collecting information as to the amount of garbage requiring destruction in the incinerator which the city health department is about to build by day labor.

W. H. Frost, proprietor of the Smith's Falls, Ont., Malleable Iron Works, is asking the town for a $10,000 bonus on condition of the works being so extended as to employ 50 more men. Freedom from taxation is also asked.

The ratepayers of Fort William, Ont., have been notified that the bylaw under which they proposed to borrow $35,000 for waterworks is of no effect, as more than a year has passed since the bylaw was carried. Another will be submitted.

R. A. Waite, architect, Buffalo, U.S., has been refused admission as a member by the Association of Architects of the Province of Quebec on the ground that the provisions of the constitution of the association did not permit of it.

The Truro, N. S., Headlight states that the Londonderry Iron Co. has sold the pipe plant and machine shop plant, at Acadia Mines, N. S., to the People's Heat and Light Co., of Halifax, and that it will be removed to that place this winter.

A large saw mill is being erected at Lake Temiscouta, Que., by James Miller, of St. John, and D. A. Huntley, of Parrsboro. The mill, which is to begin operations next spring, will have a capacity of about 15,000,000 feet of lumber during the summer season.

R. Gray, J. S. Gray, M. Daniels, J. McEwen and M. Campbell, Chatham, Ont., are applying for incorporation as The Wm. Gray & Sons Company, Ltd., to manufacture all kinds of vehicles including bicycles. Chief place of business, Chatham, Ont.; capital, $150,000.

C. B. Frost, F. T. Frost, M.P., C. H. Frost, Maria E. Frost, and Caroline L. Frost, Smith Falls, have applied for incorporation as The Frost & Wood Co., Ltd., to carry on the machinery manufacturing business of Frost & Wood, Smith's Falls; capital, $800,000.

The Maritime Sulphite Fibre Company, Chatham, N. B., has ordered a 500 h.p. cross compound condensing engine from the Robb Engineering Company, Amherst, N. S., to replace their present 250 h.p. simple engine, and to provide for contemplated enlargements of their plant.

The cold storage building going up in London, Ont., at a cost of $40,000, is being built by Henry Lucas, Toronto, who has the contract for the brickwork and masonry. Hilliard & McKinley, London, will do the carpentering, and the iron work was awarded to the London Foundry Company.

Following is a copy of a letter sent from the Globe File Mnfg. Co., Port Hope, Ont., to the Dodge Mnfg. Co., Toronto, dated, Oct. 3rd, 1898: "We are reminded by your Mr. Hass that we have not told you how we like the last rope drive. We may say immense. We put it up as per your plans, started it to run and it went off so well we have only adjusted one pulley since. You may refer persons to us when talking rope drives. We would not return to gears again for four times what the four drives cost us. We feel you have used us well, we wish you made the ropes too, as we have faith in your ability."

The evidence in the arbitration for the ex-appropriation of the Campbelltown, N.B., waterworks is finished, and the Court adjourned until November 16th, when the argument will be heard. Willis Chipman, civil engineer for the town, values the plant at $51,000, and Jas. Laurin, civil engineer for the company, at $123,180.

The Model gas and gasolene engine which is being manufactured and placed on the market with great success by the Goldie, McCulloch Co., of Galt, Ont., is a very light running, economical and useful engine, and is especially adapted for small installations.

Price Bros., Quebec, have bought ground at Batiscan, Que., for the erection of a saw mill, to which will be transferred their present business at St. Stanislas. The mill will be equipped with the latest modern improvements, lighted by electricity, and with a capacity of 200,000 logs per season.

The contract for laying a 10-inch main for the municipality of Verdun, Que., has been awarded to Matthew Dineen, contractor, Montreal. The Three Rivers Iron Works Co. is to supply the cast iron pipes and specials. Work was commenced on the 10th inst., under superintendence of McConnell & Marion, civil engineers, Montreal.

C. A. Birge, manager of the Canada Screw Company, Hamilton, Ont., states that he knows nothing concerning the probable sale of the works in this city, beyond the fact that the directors of the company have been empowered by the shareholders to make such disposition of the property as may be to the best interests of those concerned.

The Diamond Glass Company, Hamilton, Ont., which bought out the Toronto Glass Works about two years ago and transferred the blue-glass works from Hamilton, will remove also the flint-glass works, better known as the Burlington Glass Works, to Toronto, where exemption of taxation for its works has been secured for ten years from Jan. 1st next.

The Terra Nova Boiler and Engine Works, Ltd., St. John's, Nfld., has been formed, of which Hon. E. R. Bowring is president; Hon. A. W. Harvey, vice-president, and J. Anderson, secretary, with a board of directors consisting of Hon. J. Baird, J. Browning, W. B. Grieve, W. C. Job. The old business in Hoylestown has been taken over and will be greatly enlarged.

The St. John, N. B., Sun and other New Brunswick papers are discussing with a great deal of vigor the fact that various bridge contracts have been let without being advertised in the daily papers, and that changes have been made in the plans after the contracts were awarded, which materially cheapened the work. The Sun charges that in some cases those changes amounted to 50 per cent of the cost of the work.

The bylaw to make a loan of $30,000 to the Wm. Hamilton Mnfg. Co. has been carried by the ratepayers of Peterborough, Ont. The company will put up a new building 100 feet wide by 350 feet long, and 60 feet to the peak of the roof, paralleling the G. T. R track. A switch from the G. T. R. line would be laid through the building. The company is to pay 3½ per cent. for the loan, and to repay it, principal and interest, in 20 years.

The Lachine, Que., town council intends to take up the question of town drainage in a serious manner this coming winter. This question has been agitated for years, but in view of the large increase in population it presses for solution. The difficulty in the way seems to be a place or means of disposal, as it is impossible for Lachine to follow the filthy custom of the continent and pour its sewage into the river, to pollute the water supply of Montreal.

The E. B. Eddy Co., of Hull, have just installed what is probably the largest paper machine in Canada. The frame of the machine is 153 feet long, and it has thirty 120-inch driers. It is provided with ring oilers and the cylinders are cast hollow in one piece by a patent process. The bottom calendar roll weighs 1,585 lbs. The machine is driven by a 250 h p. engine, and is capable of producing 20 tons per day of news, manilla or wrapping paper.

J. G. Pennycuick, F. W. Barrett, J. O. Buchanan, E. W. Cox and F. Wyld, Toronto, Ont., are being incorporated as The Pennycuick Glass and Light Corporation of Toronto, Ltd., to manufacture prisms, prismatic-glass, prismatic-globes, glass-conduits for electric wires, glass-tiles for wall decoration, and all products and articles relating to and necessary for the transmission and distribution of natural or artificial light; capital, $40,000; chief place of business, Toronto.

The electric motor carriages being built by the Canadian Motor Syndicate with the Still system of storage batteries are proving very successful. The carriages weigh, with batteries complete, only 750 lbs., and on a recent test the carriage ascended the steepest hills in Toronto, with the roads in a very unfavorable state, there being a great deal of mud. One of the leading business firms of Toronto has ordered a delivery van equipped with the Still batteries.

Since the advertisement was published calling tenders for the construction of the Quebec bridge, numerous applications have been received for information upon which to base tenders. Some of these come from England, France, Belgium, Canada and the United States. As it will cost contractors a large sum to make up a tender and the exhaustive plans that will require to accompany it, the number of actual tenderers is likely to fall very short of the number of those seeking present information.

The Syracuse Smelting Works, which recently opened a branch in Montreal for the manufacture of solder and babbit metals, have been so successful in extending their Canadian output, that it has been necessary to add another furnace to the works, making three now running. Business continues to be brisk and the company has just made a shipment of two cars of babbit metal and solder to Halifax, and two cars to St. John, N. B. They report their trade increasing all through Canada and prospects very bright.

Up to Sept. 1st last, the Detroit Lubricator Co., of Detroit, Mich., had manufactured and sold 400,000 Detroit Sight Feed Lubricators, and it is continuing at the rate of from 5,000 to 7,000 per month. Lubricator No. 400,000 went to South Africa, while lubricator No. 399,000, made about a week earlier, went to Java. Wherever there are steam engines, or any other kind of engines for that matter, the Detroit lubricators are in evidence, preventing friction, saving fuel, and making the lives of the engineers, as well as the machinery, run along more easily.

An important judgment was recently given by Judge Morgan, Toronto. Over a year ago the Canada Illuminating Company sold the Victor Light, which the Auer Light Co. claimed was an infringement on their patents. The Auer Light Co. started proceedings, and the judgment was given in a test case in favor of the Auer Light Co., holding that the Victor light was an infringement, and ordering damages at $2 per light. His Honor also ordered that the brasswork be delivered to the plaintiffs.

F. W. Eddy, West Newton, Mass., has bought land in Margaree Harbor, Cape Breton, where he will erect a large saw mill. The mill will have a 30 h.p. engine and boiler, rotary mill, shingle machine and a stave machine, consisting of a cylinder saw, heading rounder and stave joinder. The machinery, which is being supplied by the Robb Engineering Co., Amherst, N.S., will be on the ground and fitted up by the middle of November. This will be, it is said, the most completely equipped saw mill in Cape Breton.

The annual inspection trip of the directors of the Canada Iron Furnace Company, the Radnor Water Company and the Shawenegan Water & Power Company, was recently made the occasion of a pleasant excursion to what is rapidly becoming one of the industrial centres of Canada. Among the party were: Hon. Mr. Marchand, Premier of Quebec; P. H. Griffin, president of the Canada Iron Furnace Company; J. G. Smith, A. F. Gault, T. J. Drummond, W. J. White, E. L. Pease, Dr. W. H. Drummond, J. N. Greenshields, Alex. Pringle, Montreal, and Melville Aldred, S. Bagley, Capt. Piorkowski, of the German army, representative of the famous Krupp gun makers.

There was a large gathering of Ottawa Valley lumbermen recently at the W. C. Edwards' & Co., Ltd., mills, Ottawa, to see the test of the process for conversion of sawdust into commercial products. Prof. Ruttan, McGill University, Montreal, was also present. The visitors were shown through the building where the machinery is, and saw at one part wet sawdust being carried into the machine proper, coming out in tarry oils, pyroligneous acid, carbon and gas. The machine gets its fuel from the gas obtained from the sawdust. Another process for the treatment of sawdust, and the production of calcium carbide and the tarry oils, pyroligneous acid, etc., is being patented.

The Penberthy Injector Co., Detroit, has won its suit against the Lee-Penberthy Manufacturing Co., restraining the latter company from using the name Penberthy on its goods. Wm. Penberthy, whose patents were bought by the Penberthy Co., and improved by it, insisted upon his name appearing on the injectors. When he withdrew from the company and organized the Lee-Penberthy Co., he used his name on the injectors made by the new company. As the name had become well-known as describing the apparatus of the first company it was claimed as a trade mark of the first company and has so been allowed by the Court.

The Sarnia Salt Company, Ltd., of which Wm. Lord Moore, Chicago, is president, and W. J. Hume, Sarnia, secretary, has applied for permission to increase its capital stock from $20,000 to $100,000. The works of the company have been idle for some time, but it is intended to resume operations on a large scale. This development of the Canadian salt wells is not improbably connected with the prohibition of the export of Canadian logs to Michigan, says The Sarnia Despatch. The Michigan salt wells use the refuse from the lumber mills as fuel, and when that is cut off the cost of operating them will be greatly increased, thus affording a material advantage to the Canadian wells.

The Rossland Air Supply Co., Ltd., has been incorporated in British Columbia, with a capital stock of $200,000, and having for its subscribers C. K. Milbourne, Nelson, manager of the Dominion Mining, Development and Agency Company, and of the Cascade Water Power and Light Company; A. J. McMillan, Rossland; D. J. Fitzgerald, Trail; W. S. Norman, Rossland and Spokane, and F. Aug. Heinze, Butte, U.S. The company will develop water powers by the use of compressed air under what is known as the Taylor hydraulic air compression system, which has been fully described in former issues of The Canadian Engineer. The 14-inch air main from the place of development to Rossland will cost in the neighborhood of $130,000.

An important change has been made in the course of lectures on "Steam and the Steam Engine" at the Toronto Technical School. This consists of dividing the subject into two parts, so that as well as the lectures on "the theory of heat engines or thermodynamics" others will be given of a practical nature, dealing with "the indicator, valves and valve motions, efficiency of engines and boilers, gas engines," etc. Harris Elliott, B. A. Sc., who has charge of this course, has had considerable experience in the actual design and construction of engines, and it is hoped that in this way it can be made interesting to mechanics and others who are not qualified to take the theoretical work. The practical lectures commenced Oct. 21st, at 8.30, with a discussion of "the indicator and how to use it."

The Ontario Government has concluded an agreement with an English syndicate by which E. A. Bremner, London, Eng., has secured from the Government the right to cut spruce timber on a reserve along the Sturgeon river.. The tract consists of 75 square miles of spruce lands. The company engages to spend a million dollars in buildings and plant, and will have an operating capital of two and a half millions. The pulp mill was formally opened at Sturgeon Falls, Oct. 1st, and the foundation of the first of six paper mills has been laid. The company undertakes to employ not less than 240 hands. The output will be 120 tons per day. The terms of the contract with the Government provide that all spruce cut must be manufactured in Ontario. Wm. G. Finlay, Lawrence, Mass., who has had eighteen years' experience, has been engaged as working manager.

Fetherstonhaugh & Co., patent solicitors, of Toronto and Montreal, furnish the following list of patents relating to machinery or engineering, granted to Canadians in the following countries. Any further information may be readily obtained from them direct: Canadian Patents.—Tanning machinery: J. H. Smith; automatic car-couplers, P. Hoff and E. Francis; belt shippers, C. Dawson; wire tightening device, O. Johnson; spring-cable, tension device, T. S. Witman; valves, F. Roy; frame saws, L. Long; hollow spring wire cable, J. Morlock; automatic switches, F. W. Ross; rock crusher and pulverizer, R. B. Seabrock; machine for weaving wire fence, J. Rocheleau; method of extracting precious metals from pulverized rock or sand, J. F. Latimer; machine for washing gold, E. L. Tetreau and W. M. Ogden; apparatus for separating ores, minerals, etc., W. T. Newman; trolley bases, H. G. Taylor. American Patents.—Apparatus for mining in frozen ground, S. H. and E. B. Haycock; chemical engine, T. Down; mechanism for imparting successive or alternating movements, E. Moore.

J. A. Simmons and the International Sanitary Gas Company, West Virginia, have begun suit in the United States Court against L. G. Harris, Toronto, to enforce a contract which they claim he refuses to carry out. Harris is the patentee of a method of making gas from garbage. It is alleged in the complaint that he agreed to sell to Simmons, or to a company which he was to form, all the patents he had obtained or might obtain, for the sum of $500,000. He was to receive $1,000 on the signing of the contract, and $5,000, $24,000, $25,000, $25,000 and $200,000 in one, two, four, five and six months from that date, the balance to be paid within a year. It was further agreed that when the company was formed all of the capital stock was to be turned over to Harris as security, and he was to deposit it with the Manhattan Trust Company. In case of default of the payments, Harris had the right to break the agreement. The company was formed and the agreement was signed on April 27, 1898, and since that time it is alleged that Harris has been paid $10,000. When a tender of the stock was made he refused to accept it, claiming that the contract was void. The claimants ask that the Court issue an order compelling him to carry out the terms of the contract and restraining him from disposing of the patents.

Electric Flashes.

Hull, Que., is having estimates prepared for a municipal lighting plant.

The Rogers Electric Co., London, Ont., is establishing a branch in Toronto.

Edward A. Evans succeeds F. H. Badger as manager of the Montmorency Electric Light and Power Co.

C. Snell and Tremaine have bought the electric lighting plant from the Exeter Electric Light Co.

The Cataract Power Co. began to supply power for incandescent lighting to Hamilton, Ont., Oct. 23rd.

The C.P.R., Montreal, has purchased a two-phase induction motor from the Canadian General Electric Company.

The Canadian General Electric Company has sold an electric plant to the Oxford Mnfg. Co., Oxford, N. S.

The Hamilton, Ont., Radial Electric Railway Co. will extend its line from Burlington, Ont., to Port Nelson.

Munderloh & Co., Montreal, have purchased a 200 light dynamo from the Canadian General Electric Company.

At a recent meeting of those chiefly interested in the Cornwall Street Railway several extensions and improvements were decided upon.

Jos. S. Craig has been appointed electrician to the Toronto Fire Department in place of Electrician Gibson, who has resigned from illness.

Glace Bay, Cape Breton, is to be lighted by electricity. Over 800 lights have been already subscribed for, and the plant will be installed this fall.

The Lachine Rapids Hydraulic Land and Power Co. has placed another order with the Canadian General Electric Co. for a three-phase induction motor.

Whitby, Ont., has sat in darkness recently, owing to a disagreement between the town council and the local lighting Company as to the renewal of a contract.

The British Columbia Sugar Refinery Co., Vancouver, B.C., has purchased from the Canadian General Electric Company one of its new type 25 k.w. multipolar generators.

W. C. McDonald, Montreal, whose generous gifts to McGill University have caused him to be held in honor all over the Dominion, has made an additional donation of $35,000, to be spent on the Department of Electricity in raising it to the same standard of completeness as the other departments.

James Donaldson, Bayfield, Ont., has disposed of his electric light plant and saw mill to N. M. Contine, St. Joseph, Ont.

Bradford, Ont., has accepted the tender of the Johnston Electric Co., Toronto, of $1,900, for installing and equipping an electric light plant.

The T. Eaton Co., Toronto, has ordered a 50 h.p. automatic engine for direct connection to dynamo, from the Robb Engineering Company.

Port Perry, Ont., council has granted Dr. Mallow the right of erecting telephone poles on certain streets so as to connect with Prince Albert, Ont.

J. Robinson & Co., Winnipeg, Man., have purchased a 10 h.p. slow speed 500 volt multipolar motor from the Canadian General Electric Company.

Jos. Graham, sawmill owner, Grand Valley, Ont., is burning his mill refuse to generate electricity to light the town of Arthur, Ont., ten miles away.

The Ottawa Street Railway Company will install a large storage battery plant to compensate for the fluctuation in power caused by anchor ice in winter.

W. B. Lanigan has retired from the Board of Directors of the Galt, Preston and Hespeler Street Railway. J. W. Leonard, superintendent of the C.P.R., succeeds him.

The London Electric Company has just placed an order with the Canadian General Electric Company for two standard No. 12 125 light multi-circuit Brush arc dynamos.

The Gulline Pneumatic Collar Co.. Granby, Que., is putting in a large electro-plating apparatus, building an addition to the factory, and increasing the size of the steam plant.

W. Miller, Esq., Glen Miller, Ont., is installing a new electric plant for his paper mills, and has purchased a 150 light machine from the Canadian General Electric Company.

J. C. Wilson & Co., Lachute, Que., have purchased from the Canadian General Electric Company for the lighting of their premises, a standard 17½ k.w. multipolar generator.

The Petrolia Topic thinks that the proposed electric railway from Sarnia to Petrolia would be a big benefit to the tunnel town, but Petrolia would be deprived of considerable trade.

G. H. Harper, R. T. Wilson, J. J. Grafton, E. B. Harper and John Bertram, Dundas, Ont., have been incorporated as The Dundas Electric Company, Ltd., with a capital of $40,000.

G. T. Simpson, electrical manufacturer, Hamilton, Ont., was recently acquitted of a charge of unlawfully obtaining electrical energy from the Electrical Power and Manufacturing Co., Ltd., Hamilton.

James Barry of Niagara Falls, Ont., John Ross and John McRae have been given a contract for work amounting to $300,000 on the development of electrical power at Shawenegan Falls on the St. Maurice.

The C. O. Dell Electric Company, Annapolis, N. S., is doubling the capacity of its plant. E. Leonard & Sons have shipped them a large Leonard-Ball automatic engine, 120 h.p., from St. John, N. B.

Some of the influential citizens of Ste. Genevieve and Point Claire, Que., are considering the uniting of the two parishes by an electric road, having for its object enlarged facilities for communication with Montreal.

A movement is on foot in Ridgetown, Ont., to have an electric railway built between that town, Thamesville, Morpeth and Rondeau Park. Robt. Ferguson, M.P., and W. E. Gundy, are among those chiefly interested.

Prof. Rutherford, McGill University, delivered a most interesting lecture with a practical demonstration, on "The electrical transmission of messages without wires," before the Applied Science Society of McGill, recently.

J. A. Jamieson, superintendent C.P.R. elevators, St. John, N.B., has given an order to the Canadian General Electric Co. for a 30 k.w. generator, together with all the wiring material required to complete the installation.

R. McCallum, C.E., of the Public Works Department of Ontario, has inspected the power works of the Keewatin Power Co. for the Government. Alex. McQuarrie has been appointed manager of the works at Rat Portage, Ont.

Application for incorporation will be made to next session of the Ontario Legislature on behalf of the Toronto Elevated Railway Co., which wishes to build elevated and surface railways in Toronto and adjoining municipalities.

The town council of Port Arthur, Ont., has made an arrangement for an electrical and water supply from the Jenison power canal, at Kakabeka Falls, which was described briefly in our last issue. The contract has to be submitted to the electors.

The directors of the Victoria Industrial School, Mimico, Ont., have decided to install an electric plant for the lighting of the various buildings, and to carry out this work have purchased a 300 light plant from the Canadian General Electric Company.

L. Paquette, a workman employed at a building in the course of construction in Montreal, met his death a short time ago in a peculiar manner. He was working on a derrick, and the boom touching an electric wire formed a circuit through his body. Death was instantaneous.

The Canadian General Electric Company has just received an order from Wm. Cook, St. Catharines, for a standard 60 k.w. single-phase alternator. It is Mr. Cook's intention to undertake the furnishing of light to private consumers in connection with his present power plant.

The Hull Electric Company, Ottawa, is increasing its generating plant, and have purchased from the Canadian General Electric Co., a standard monocyclic generator, having a capacity of 150 k.w., with marble panel switchboard and instruments complete. This makes the third machine of this size type which this company has purchased.

The Department of Electrical Engineering, McGill University, Montreal, is adding to its electrical equipment a number of special generators, motors, transformers and testing instruments to be used in connection with the experimental work. An order has been placed for these requirements with the Canadian General Electric Company.

A Piers, superintendent of the C.P.R. Co.'s steamship lines, has placed an order with the Canadian General Electric Company for a direct driven unit to be installed on the steamer Alberta. This consists of a 25 k.w. generator, direct connected to a 9x10 "Ideal" engine. The order includes a marble panel with standard instruments and wiring.

H. Cargill & Son, Cargill, Ont., have decided to install an up-to-date electric plant for their requirements to furnish light and power to their residences, mills, barns and warehouses, and for this purpose have purchased a 500 light plant from the Canadian General Electric Company, together with several motors for operating machinery and elevators.

L. Becigneul et Cie, Lake Megantic, Que., are installing an incandescent electric system for the town, and for that purpose have purchased from the Canadian General Electric Company a standard 30 k.w. single-phase generator with marble panel switchboard complete. They have also placed an order with the same company for all transformers and wiring supplies required to carry out the work.

The corporation of Campbellford, Ont., has recently passed a bylaw for the purpose of remodeling and increasing its electric plant, and to carry out the work, has purchased from the Canadian General Electric Company a standard 120 k.w. single-phase alternator complete, together with all the transformers and wiring material required to carry out the work. It is expected that this will be one of the most modern plants in Canada when completed.

R. B. Owens, the new professor in charge of the electrical department of McGill University, is introducing a new feature which will be of great value not only to the students but will also confer great benefit upon the general public. This is the standardizing laboratory. There will be a room devoted to high potential machinery where a voltage of 200,000 will be obtainable. The old shafting in the electrical department is all being taken down and each machine will be driven by a separate motor. There will be machines of the various types—single-phase, two-phase, three-phase, and synchronous motors. New types of high tension transformers and alternating current machinery are being installed. Prof. Owens has been given practically a free hand in reconstructing the laboratories.

The Canadian General Electric Company has received an order from the T. Eaton Company, Toronto, for a 25 k.w. direct connected generator with marble switchboard. This makes the fifth unit which the T. Eaton Company has purchased from the Canadian General Electric Company, the entire establishment being lighted and operated from these installations.

Howes & Leighton, Harriston, Ont., has decided to comply with the request of the merchants of that place to provide incandescent lighting for commercial and residential purposes, as well as arc lighting, which they are now furnishing, and for this purpose have placed an order with the Canadian General Electric Company for one of its new type 30 k.w. single-phase alternators, with marble panel, instruments and all the transformers and wiring required for the installation.

The People's Telephone Company, of New York, was incorporated Oct. 12th with a capital stock of $5,000,000, to operate a telephone system in New York city and in other cities, towns and villages in New York and other States, and in the Dominion of Canada. The capital stock is divided into $2,000,000 preferred and $3,000,000 common stock. The directors are: S. B. Dutcher, J. E. Nichols, E. S. A. Deluna, Francis C. Travers, Frank Brainard, J. Fred Ackerman and Darwin R. James, New York.

The Metropolitan Electric Company, Ottawa, which was given a charter by the city council, recently, is applying for a charter of incorporation, with a capital of $500,000. James Robinson, F. Cains, Montreal; A. Broderick, T. Lindsay and W. Arnold, Ottawa, are the directors. It is stated that the company has bought the immense water power on the Ottawa river at Britannia, just above the city of Ottawa, from J. R. Booth for $20,000.

At the annual meeting of the Standard Light & Power Co., Montreal, the following directors were elected: W. McLea Walbank, president; J. H. Burland, vice-president; Peter Lyall, W. S. Evans, F. Dagenais, M. P. Davis. The company is now installing two large motors recently bought from a firm in Cleveland, Ohio. These will be operated from the Lachine rapids, holding the steam plant in reserve. It was decided to ask for tenders for rotary converters and fire-proof the Chenierville street power station.

Within another year Quebec, it is said, will be one of the best lighted cities in the world. It will have no less than three companies converting water powers in its vicinity into electricity. They will be the present Montmorency Falls Company, the Chaudiere Company, now in course of formation, and the Jacques Cartier Water Power Company, which has already commenced to build at the falls of the Jacques Cartier river in Valcartier, some 18 miles from the city of Quebec. This company will, it is said, build large pulp and paper mills at the falls.

Barrie, Ont., is determined to have cheap electric light, and will establish a plant of its own, unless the existing company sells out to the town at the town's valuation. Now the council cannot raise money for the new plant without issuing bonds. To issue bonds requires the consent of the county council. The county council holds $10,000 stock in the light company as security for the deficit of an absent county treasurer, and naturally does not see the reasonableness of aiding a competitor starting in business.

H. D. Symmes, St. Catharines, Ont., has secured the contract from the corporation of Merritton for street lighting with 20 arc lamps. Mr. Symmes has also decided to undertake the operation of a commercial lighting plant, and for his requirements for this purpose has purchased from the Canadian General Electric Company one of their 1,000 light, standard, single-phase alternators. He proposes operating a street lighting service from the alternating system, using 2,000 c.p. enclosed alternating arc lamps. These lamps he has also purchased from the Canadian General Electric Company.

Mining Matters.

Gold mining is being undertaken in Pontiac county, Que.

It is proposed to put in a smelter at the copper mine at Lower Wentworth, N. S.

Deseronto, Ont., is importing iron ore from Marquette, Mich.

W. Ogilvie, the new administrator of the Yukon, arrived safely at Dawson City, Oct. 5th.

There seems to be quite a revival of gold mining on a profitable scale in the Chaudiere Valley, Quebec.

A twelve-drill electric compressor for the Iron Mask has been ordered and is expected to be in operation in the course of a few weeks.

Gold and silver bearing quartz are reported from Chipewyan as being found on many of the islands in Great Slave lake.

The new machine plant in the Deer Park mine, Rossland, B.C., is working admirably, and Superintendent Mulholland is much pleased with it. The shaft is now down about 280 feet.

A report from Asbestos, Que., states that the asbestos company there is turning out several tons of asbestos per day. A new vein has been discovered, and is pronounced the richest yet.

Mica of a quality that has not been equalled so far, is reported from a point 200 miles north of Kamloops, B.C. The deposits are said to be 40 to 80 feet in thickness and great extent.

Reports from Cape Breton state that an immense deposit of magnetic iron was lately discovered there, running in width to 1,000 feet, and two miles long. Several shafts are now sunk across the lead 200 feet apart.

The first motors to be installed in British Columbia for the purpose were started up by the West Kootenay Power and Light Co., Ltd., at the works of the B.C. Bullion Co., Silica, about three miles from Rossland, B.C., Oct. 16th.

It is said that before summer comes again, the weekly ore shipments of Rossland, B.C., will reach the 10,000 ton mark. This result can easily be attained by shipping ore that is already in sight on the Centre Star, Columbia-Kootenay, No. 1, Monte Cristo, Deer Park, Virginia, and the Velvet.

Charles W. Willimott, of the Geological Survey of Canada, has recently been exploring for molybdenite. He found large deposits near Desert, in Ottawa county, and in Pontiac and Ross. He advises Canadian owners to retain what molybdenite bearing lands they may have.

It is reported from St. John's, Nfld., that the Montreal syndicate that have been boring on the west coast have found oil in the three wells which have been sunk, and the quality is said to be first-class. The Newfoundland iron mines have sold this year 86,000 tons of ore to Germany, while the coming year Germany will, it is said, take 160,000 tons.

J. Harvey is now operating in Manitoulin Island, with one of Fraser & Harvey's rigs and a crew of men, drilling for a firm of American prospectors. Their contract calls for ten wells, to be sunk from 500 to 800 feet each, according to the "show" they get. Oil and gas in small quantities have been stated to exist for some time, and an effort will be made to develop them on a commercial basis.

The double compartment shaft on the Iron Horse mine, Rossland, B.C., has now reached a depth of 34 feet, and two sets of timbers have been installed. The ground for the seven drill compressor has been selected. The intention is to use coal for fuel, and in order to save the haulage the plant is located alongside the railway track, so that the coal can be delivered direct to the furnace from the cars.

A gentleman representing a large English smelting firm has been in Canada for some time lately endeavoring to secure a shipment of iron ore from a Canadian mine in order to test the properties of the Canadian article. He made a proposition to several owners that they should let him have 500 tons at a certain figure, on the condition that if the ore turned out to be satisfactory, his firm would purchase anywhere from 100,000 to 200,000 tons per annum. He expected the owners of undeveloped iron properties in Canada would be only too glad to have their ores tested in this way. He found, however, that none of them were willing to let him have the 500 tons without receiving a cash payment of more than the ore was worth and a great deal more than it could be obtained for in the United States, where he finally went for his ore samples.

H. W. Treat, New York, secretary of the Van Anda Mining Company, stated a short time ago that their properties on Texada island were improving daily in development. They have reached 200-foot level by a double compartment shaft, and at 180 feet the ore body has widened out to 20 feet; seven feet of this went $50 to the ton, and the other 13 feet $12 per ton, and is splendid concentrating ore. At the 200-foot level it opens up a magnificent body of copper glance, four feet of which is 25 per cent. copper. He states that a complete smelting plant is there ready for erection with the exception of the boilers.

W. A. Parks, lecturer in Toronto University, the geologist who accompanied the Niven survey party into Northern Ontario this last summer to extend the boundary line between Nipissing and Algoma, has returned in advance of the surveyors, to his duties in the university. Two years ago the Niven boundary line was run for a distance of 120 miles, terminating just north of Night Hawk lake. This season the work was resumed at the latter point, with the expectation of extending the survey to the Moose river, and thence connecting with Moose river. When Mr. Parks left the party the line had been extended for about 120 miles from Night Hawk lake to a point 16 miles east of the Abittibi river.

Rich gold fields have been discovered at Lake Atlin, in British Columbia, and the district is east of the summit of the Coast Range. Promising placers and good quartz have been found in the neighborhood of Lorne Creek and in the Skeena Valley, also east of the summit of the Coast Range. A gentleman, who spent the summer on the upper waters of the Lillooet, says, in The Victoria Colonist, that gold is distributed everywhere. He does not claim to have made any great discovery, but says that quartz veins are many and all of them carry gold. What there is in them can only be determined by development work. Such work as is in progress is full of encouragement. The existence of gold bearing country at these points along the eastern slope of the Coast Range suggests that what may be called a secondary gold belt extends along this whole region, which is about 800 miles in length.

Railway Matters.

The Canadian Pacific Railway Company is improving its elevator facilities at Port Arthur, Ont., by adding an extensive drying plant.

C. M. Hays, general manager of the Grand Trunk Railway, has ordered the construction of 200 additional flat cars for the system from Portland to Chicago.

The Collins' Bay Towing and Rafting Co., Kingston, Ont., have taken the contract to remove the wreck from the scene of the late Cornwall railway bridge disaster.

Mrs. F. Walker, Brooklin, has begun an action against the Ottawa, Arnprior and Parry Sound Railway for $10,000 damages for the loss of her late husband in a collision in May last.

The pople of Amherst, N.S., are promoting a railway from that town to North Port on the Northumberland Straits, about twenty miles, affording an outlet to an extensive coal and lumber country.

The lake steamer Empress of India was put into the dry dock at Picton and cut up into three. Her length will be increased by 45 feet, which will make her 227 feet long, and other improvements made.

The Lake Erie & Detroit River Railway will make another application to the towns and villages along the route for bonuses to aid in the extension of the line from Ridgetown to St. Thomas, Ont.

The contract for the construction of about thirty-five bridges between Montreal and Vaudreuil on the Montreal & Ottawa Short Line, which the C.P.R. Co. intend double tracking, has been secured by J. W. Munro, of Pembroke.

The Canadian Pacific has issued a circular, giving the hauling power of every locomotive on the line, and also what each one will carry, on every point in the division. By this new scheme, a trainmaster can see at a glance how many tons to put behind an engine.

Thos Power, contractor, has just finished the work on three bridges on the Drummond County Railway. The first in two spans over the St. Francis, 400 feet long and 35 feet high; the second over the west branch of the Nicolet, 140 feet long and 42 feet high, and the third at Petit Dechene, Moose Park, 100 feet long, and 32 feet high.

The Dominion Government railways system has awarded contracts for the construction of 300 box cars and 100 flat cars for use on the Intercolonial Railway. The Crossen Car Manufacturing Company, Cobourg, Ont., will furnish 100 box cars; the Ratlbun Company of Deseronto, 50 box cars, and a Nova Scotia company the remainder.

The United States Supreme Court has decided that the Joint Traffic Railway Association is an illegal body. This judgment will have far-reaching effects. The association, of which the Grand Trunk and C.P.R. were members, was formed in 1895, its object being to establish and maintain reasonable and just rates, fares, rules and regulations on state and interstate traffic.

Hugh D. Lumsden, C.E., who has been in charge of the survey which the Canadian Pacific have been making from near Toronto to a few miles east of Sudbury, has returned. Mr. Lumsden reports that the survey is about complete and that a good line has been secured, starting from Clineberg, on the old Toronto Grey & Bruce, to a point four miles east of Sudbury, a total distance of 247 miles.

The Restigouche & Western Railway is making good progress under Engineer C. L. B. Miles. The first sod was turned Aug. 12 and ten miles of road were completed by Nov. 1.

The new shops of the Quebec Central Railway to be erected at Newington, Que., are to be operated by electric motors, the current being supplied by the Gas & Water Co., Sherbrooke, Que.

Application will be made to the Ontario Legislature for an Act to incorporate the Haliburton, Whitney & Mattawa Railway, to construct a railway from a point at or near the present terminus of the Grand Trunk Railway at Haliburton, to a point on the Ottawa, Arnprior & Parry Sound Railway, at Whitney, Ont., and in a northerly direction to Mattawa on the Ottawa river.

Important changes have taken place recently in the Intercolonial Railway. The position of general superintendent has been created and the office will be filled by Jas. E. Price, with headquarters at Moncton, N.B. The position of district superintendent, vacated by Mr. Price, will be taken by G. M. Jarvis, with headquarters at Truro, N. S. H. Fleming, late district train despatcher at Moncton, has been appointed chief train despatcher, with headquarters also at Moncton.

Surveys are being made for the proposed Ottawa, Bancroft and Irondale Railway, which is to connect the Ottawa, Arnprior and Parry Sound Railway at Carp, Ont., with the C.P.R. at Almonte, and thence southwest through the iron regions of Lanark and Hastings counties to the G.T.R. at Bancroft.

It appears probable that a railway into the Cariboo country in British Columbia will be built, the line running from the C.P.R., near Ashcroft, to Barkerville.

Considerable progress is being made with the construction of the Baie des Chaleurs railway, and with the preparations to make the port of Paspebiac an ocean terminus. At present the railway is within about three miles of Paspebiac, where the construction of a large pier to stretch out a hundred feet from the bar is being vigorously pushed. It will accommodate vessels of the largest tonnage and have at low water a depth of 36 feet. It will, it is expected, be completed by December, when the railway will also reach Paspebiac.

The Canadian Pacific Railway Co. has under consideration a proposition from interested parties for the construction of the Napierville Junction Railway. This company was incorporated in 1878 by an Act of the Legislature, with power to build a railway from a point in the parish of St. Remi to a point in Napierville with the privilege of extending its line in the county of St. Johns. Between 7 and 8 miles of the road have been constructed. A bonus of $2,500 has been voted by the municipality of St. Edward, $10,000 by the municipality of Napierville, and a subsidy of $3,200 per mile by the Federal Government, and as much by the Local Government.

Although the Government officials who examined the wreck of the railway bridge at Cornwall, Ont., have been very reticent about the matter, it is the general impression that the cause of the disaster was established to be the defective foundation of the piers. Warned by the disaster at the United States end of the Cornwall bridge, the chief engineer of railways and canals has decided to have the foundations of the piers at the Canadian end of the bridge tested by boring. This will determine whether the concrete has properly set under water, and whether the river bottom on which it rests is sufficiently solid to make the foundation of the piers secure.

Regarding the renewal of bridges the semi-annual report of the Grand Trunk Railway says: The president reported to the proprietors, at the last general meeting, that in addition to the reconstruction of the Victoria bridge at Montreal, it had been deemed necessary to the more efficient and economical conduct of the traffic to authorize the renewal during the next two or three years of the bridges on the section of the line between Montreal and Portland, and it has also been determined to renew certain bridges on the southern division used jointly by the Wabash Company. The proportion of the expenditure for reconstruction of the Victoria bridge properly chargeable to revenue has been fixed at £110,000, which together with the cost of renewing the bridges between Montreal and Portland, and on the southern division, it is proposed to charge to revenue account, spread over a period of at least five years, so as to obviate any undue increase in the maintenance charges in any one year. The reconstruction of the Victoria Jubilee Bridge has progressed satisfactorily, and it is expected that the new double track will be available for traffic by the 1st January next. Meanwhile the traffic is being conducted over the single track as heretofore.

The semi-annual report of the directors of the Grand Trunk Railway Company, which was presented at the half-yearly meeting in London, Oct. 13th, showed: Gross receipts for 1898, £1,871,733, as against £1,756,566 for 1897; working expenses were, 1898, £1,243,833; 1897, £1,196,643; leaving a gross profit of £627,850 for 1898, as against £559,923 for 1897. Receipts from subsidiary companies raised the net revenue to £730,672 for the 1898 half-year, compared with £654,395 in 1897. The net revenue charges for the half-year were £624,020, leaving a surplus of £106,651. The directors recommend the payment of the full half-year's dividend on the 4 per cent. guaranteed stock, which will absorb £104,395 17s. 6d., leaving a balance of £2,271 3s. 11d. The result of the past half-year's operations show an improvement of £103,943 5s. 9d. The comparative table of receipts for the half-years ending 30th June, 1898, and 1897, represents for 1898 a decrease of £25,656 in passenger receipts, and an increase for mails and express of £1,752, for freight and live stock of £99,270, and for miscellaneous of £115,168. The net increase is £115,168. The statements show that the Grand Trunk gross receipts for the half year show an increase of £115,168, or 6.56 per cent.; the working expenses, including taxes, an increase of £47,240, or 3.95, and the train mileage an increase of 430,171, or 5.17 per cent.

Marine News.

A dry dock to cost $1,000,000 is talked of at St. John, N.B.

The Montreal & Cornwall Navigation Co. have purchased the steamer Filgate.

The Steamship Pharsalia Co., Ltd., has received a New Brunswick charter; capital, $200,000.

The Government has awarded a contract for a new steel steamer for the P. E. Island service, to a Dundee, Scotland firm.

Clifford Lewis will build another steamer for the Lake of the Woods-Rainy River line. The craft is to be somewhat larger than the Edna Brydges, to carry about forty cabin passengers.

General Manager Gildersleeve, of the Richelieu & Ontario Navigation Co., recently stated that the history of the company during the season beat the record for freedom from accident. No boat had to be retired from active service, and not a single mishap occurred to a passenger.

Lyman J. Rogers, superintendent of the marine railway, Yarmouth, N.S., met with a serious accident by being crushed under a schooner, which was being hauled out for repairs recently.

The most important alteration contemplated by the Richelieu & Ontario Navigation Company in the matter of repairs to steamers will be for the placing of four new boilers in the Quebec.

The Richelieu & Ontario Navigation Company proposes to extend its Lake Ontario service from Toronto next season. The daily steamers between Toronto and Montreal will call at Charlotte, on the American side, both up and down.

Three seventeen knot steamships have been purchased for the Canadian line between Milford Haven and Paspebiac, Que., the first sailing in November. Satisfactory arrangements have been made for a special service of trains between London and Milford Haven.

Louis Lacouture, Sorel; J. O. Blondin, La Baie des Peres, Que.; D. Gillies, M.P.P., Carleton Place, Ont.; James Gillies, Carleton Place, Ont.; John Gillies, Braieside, Ont., have applied for Ontario incorporation as the Lac Temiscamingue Navigation Company, Ltd.; capital, $50,000.

Inventor Knapp, of Prescott, of the roller boat fame, has returned from Chicago, where, he states, he has succeeded in forming a strong company to carry out his roller boat patents. It will be called the Lakes Roller Boat Transportation Co., and will this winter construct a large roller boat 120 feet long. There is no reason, we believe, that if one Ottawa man financed a small roller boat several Chicago men should not finance a large one.

The manager of the Atlantic Transportation Company, W. S. Besse, New York, is buying a fleet of lake vessels for ocean service. The company was organized about a year ago, with a paid-up capital of $3,000,000, with the intention of engaging, on a more elaborate scale than any existing company was doing, in the coal-carrying trade of the Atlantic Coast. A large fleet was secured and now it is being added to by the purchase of nine steamers, at an average cost of $50,000, and thirty-five schooners, at an average cost of $20,000, or a total investment of $1,150,000. The vessels are as follows: Steamers Aragon, Kataloive, Murphy, Moore, Viking, Gettysburg and Lindsay; barges, Bacon, Georgia, Alverston, Crossthwaite, Moonlight, Verona, S. H. Foster, Sheldon and Watson; bought from J. G. Gilchrist & Co.; Redwing, Santiago, Iron State and S. V. L. Watson, bought from Parke & Miller; Wadena, Becker and Ash, bought from W. D. Becker & Co.; O'Neill & Wall, bought from C. R. Jones & Co.; Camden, Massa, Soit, Page, Sage, Milacomet, bought from Drake & Mathan; Fitzpatrick, Brown, McGregor, Parker, Rutter, Porter, Halloran, Helvetia, Wallace, Hawgood, Ewen and Shawnee bought from various companies.

Personal.

A. F Genest, C.E., is now engaged upon work in connection with the Cornwall Canal.

Peter Brass, architect, Hamilton, Ont., has been appointed building inspector of the Grand Trunk Railway.

R. K. Oliver, who has been filling the position of C.P.R. locomotive foreman at Chapleau, Ont., for some years, has been transferred to Hochelaga.

Town Engineer C. H. Mitchell, of Niagara Falls, Ont., has recently been in Potsdam, N.Y., engaged upon extensive works to generate electric power.

N. R. Carmichael, lecturer in mathematics and electrical engineering in Queen's University, Kingston, Ont., recently married Miss M. A. Jenkins, of Strange, Ont.

Arthur Graham, who has been with the MacGregor-Gourlay Co., Galt, Ont., for some years, has gone to Sherbrooke, Que., to enter the draughting rooms of the Jencks Machine Co.

Mr. Cowles, a locomotive engineer on the Leamington, Ont., division of the M.C.R., and Thomas Reid, foreman of the round house there, have both been sick for some time, and both died on October 8th.

Thomas Jones, for a long time employed with the Yarmouth Steamship Company as a quartermaster, died of typhoid fever, at his home, Jordan Falls, N.S.

W. M. Davis, who for the past thirteen years has been the town engineer of Woodstock, Ont., has been appointed town engineer of Berlin, Ont., at a salary of $1,500 a year.

Miss Myssie Munro, daughter of J. W. Munro, Pembroke, Ont., the well-known contractor, was married recently to Wm. Russel, jr., of the firm of Russel, Poulin & Co., contractors.

R. H. Cushing, C.E., has received the appointment of assistant engineer of the I.C.R. His special duties for the present will be to look after the terminal works at St. John, N.B.

Thomas Cowan, postmaster, Galt, Ont., died October 14th at the family residence, near Galt. Deceased was one of the first members of the firm of Cowan & Company, machine manufacturers, Galt.

At a recent meeting of the Ottawa city council a resolution was passed discharging the city engineer, Robert Surtees, the dismissal to take effect on November 30th. The applications for the position are very numerous.

Arch. Blue, of the Ontario Crown Lands Department, recently attended the annual convention of American Institute of Mining Engineers, in Buffalo. While there Mr. Blue delivered an address on "Corundum in Ontario."

Henry Wagner, a moulder employed at Clare Bros.' foundry, Preston, Ont., recently met with a terrible accident. He was carrying a ladle of molten metal and in some manner stumbled, with the result that a quantity of its contents was spilled over his right foot, which was frightfully burned.

Manager Keating, of the Toronto Street Railway Co., who was elected vice-president of the association at last year's session, when he was city engineer of Toronto, accompanied C. H. Rust, C.E., Toronto, to the convention of municipal engineers in Washington, D.C., at the end of last month.

Richard C. Boxall, C.E., Sackville, N.B., whose failing health has for some time been the cause of great anxiety to his friends, is now suffering from a mental malady, and all will regret to know that it has been thought best to send him to the Asylum for the Insane at St John, for treatment.

C. H. Sutherland, mechanical engineer of the Grand Trunk Railway, died very suddenly a short time ago. He had been confined to his residence for several days, but no serious results had been apprehended. However, when one of the family went into his bedroom Mr. Sutherland was found dead in his chair. Heart disease is presumed to be the cause of death.

John Duffy, St. John, N.B., foreman of construction work at the new pulp mill at Mispec, while directing work on the roof, fell over to the ground, 40 feet below. He struck a staging in his descent, thus breaking the force of his fall. His arm was injured, several ribs broken, and he also suffered severe internal injuries.

Word was received in Toronto, Oct. 26th by cable of the death in South Africa of Lieut. Keating, son of E. H. Keating, C.E., general manager of the Toronto Railway Company. Lieut. Keating graduated from the Royal Military College, Kingston, in 1888, and joined the 100th regiment, under Col. Trench, lately stationed at Halifax, N.S., and was about three months ago ordered to Africa.

Prof. Alexander Graham Bell, the inventor of the telephone, owns a whole mountain of 1,000 acres in Baddeck, Cape Breton, upon which he has expended a large sum on roads. Upon its southern slope up toward the summit, and overlooking a wide panorama of lake and mountain, he has erected a mansion, and near it a fully equipped laboratory where he conducts his experiments in electricity.

W. H. Aldridge, the manager of the Trail smelter and refiner, the property in British Columbia acquired some time ago by the C.P.R., has recently visited Montreal, and other Eastern centres. Mr. Aldridge took charge of the works at Trail when the property was purchased from the Heinze syndicate, and since that time a great revolution in the works has been effected. The plant is being worked to its fullest capacity.

Dr. Porter, Professor of Mining and Metallurgy in McGill University, Montreal, is back at the University entirely recovered from his recent severe illness. During the summer Dr. Porter has examined the mining areas in Nova Scotia and British Columbia, and is much impressed with the possibilities of mining in both districts. While in British Columbia, Dr. Porter visited East Kootenay and other districts, but was taken ill before he had examined the West Kootenay country. Dr. Porter's many friends are delighted with his complete restoration to health.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A. ROSS, E.E., M. CAN. SOC. C.E.

(Continued from last issue).

Owing to the copper losses and induction effects at various loads on the system from the generator shaft to the lamps or motors, the generator voltage must be raised as the load increases. It is very desirable that this increase be kept as low as possible, so that a continual adjustment of the voltage be not necessary, rendering the lights unsteady. To this end the copper losses, and especially the induction effects, must be kept within bounds. The first involves only the cost of the copper, the latter depends upon the nature of the demands and the relative positions of the copper conductors. The induction of lines and apparatus has an effect somewhat similar to that of the inertia of water in long pipes, and causes the current to lag behind the voltage, necessitating a large output of volt-amperes to produce watts, and, as lines and apparatus must be of sufficient capacity to carry the useless increase of current and the generator to allow for the useless additional volts, an increased capacity of plant is necessary. These induction effects may have a larger influence on the regulation than the necessary copper losses, and should be carefully watched. It is well to bear in mind, however, that the increased volt-ampere readings do not represent additional power consumption, as would be the case in direct current, as they have to be multiplied by the cosine of the angle of lag (which is always less than unity) to give the true power. Poor regulation therefore cuts down the capacity of the plant, and renders it difficult to maintain the voltage constant under varying loads. Having thus sketched the main points, which affect the general working of the plants, the apparatus may be taken up in detail.

The reducing transformers necessary for lowering the line voltage to that suitable for the incandescent distribution, arc light motors, and rotary transformers for railway service, must be of the highest grade to stand the line potential, as well as the increases of voltage to which they may be subjected under certain conditions. Of course the efficiency should be of the highest and the regulation good. As the heat developed is great, an air blast or circulation of cool oil is provided. The rotary transformers which form such a large part of the load in this case partake both of the nature of alternating motors and of direct current generators. As an alternating current motor of synchronous type they must be self starting, and in consequence are of either two or three phase. As a generator they must at the speed established by the synchronous motor part give the necessary direct current at the proper voltage for the trolley line, as both the motor action and the voltage generation take place in one set of armature windings, and as the fields are common to both, there is a certain ratio of impressed alternating voltage to direct voltage at the commutator, which is constant, and any change of field strength alters the direct current voltage only indirectly by causing a leading or lagging current in the transmission lines, thus giving more or less volts to the alternating side of the machine. Owing to this effect of over or under excitation of the rotary upon the line currents, causing them to lead or lag behind the voltage, this apparatus may be arranged to keep the current and voltage of the line in phase, thus doing away with the troubles from lagging currents which so unfavorably affect the system in the matter of regulation. On the other hand, where there is no necessity for close regulation, the line induction is encouraged, and is found useful in over-compounding the direct current side of the rotary automatically, thus giving the rise of voltage with load so desirable in railway work. In the present case, if the lighting and railway loads be carried upon separate lines, the latter arrangement is desirable, as the lighting will have good regulation while the railway service will over compound automatically. The total load for railway needs being 6,450 E. H. P., and the average from 7 a.m. to 9 p.m. being 3,000 E. H. P., seven units of 1,000 E. H. P. should cover the demands, and the machines in operation should have a good load factor. For the arc light demands as before stated, eight units would be sufficient. The motors may be either synchronous or induction, the former preferably as they may be useful in assisting the regulation of the incandescent lighting service by proper excitation, as their loads do not fluctuate. This apparatus with the necessary switchboard and in-

*From a paper read before the Canadian Society of Civil Engineers.

struments for the high potential receiving and lower potential distributing circuits, completes the distributing station equipment.

The line is usually the weakest link in the chain, being exposed to the weather, and not under that careful supervision which is given to the rest of the plant. The pole line as a supporting structure must of course be of the solidest to stand the strains imposed, not only by the weight of copper, but in these latitudes by a great weight of ice also, which if assisted by a gale will try the best work to the utmost. Poles of cedar, pine, or chestnut of very heavy section are necessary for this work. They should be set in concrete or broken stone and heavily guyed on curves, or in certain positions double poles with heavy cross arms between should be used. The insulators for high potential work are universally made of porcelain, as that material weathers better than glass and is not so hygroscopic. This porcelain should be so vitrified as to exhibit a fracture like glass when broken, otherwise it will absorb moisture and break down. To minimize surface leakage, which, if severe, may burn off the pins, the surface over which it has to take place is made as long and of as small surface as possible. To assist in reducing this leakage, insulators with oil in grooves, over the surface of which the leakage must take place, have been tried and found to work well when the oil surface is clean, but in operation dirt accumulates and troubles ensue so that the plain porcelain insulator of large insulating surface and high resistance to piercing is now the standard.

The copper circuits are of bare copper, as weather-proof insulation at high voltages is perfectly useless. The cross section of the copper being of course so proportioned as to give the loss determined upon as suitable for the conditions existing. These conditions depend upon the cost of the power, the amount available and the demands. The loss may be reduced to any extent by the use of more copper, but unless there is a demand for the power saved, which will pay interest and depreciation on the additional cost of circuits, no economy results. On the other hand, the copper may be reduced and the losses increased, but only within the bounds set by the demands of good regulation. In practice a loss of 15% is seldom exceeded, and a very common allowance is from 7% to 10%.

Several effects manifest themselves in alternating lines which do not exist on those of direct current systems, and they deserve the closest attention in planning the system. While the actual losses in direct and alternating work are about the same under the same conditions, the drop in voltage in the former is a measure of that loss, while in the latter it may be no indication. In fact, it is possible to so arrange the circuits in some cases of alternating work as to have a greater voltage at the end of the circuit than is generated at the station, but this does not indicate that the line generates power of itself; it simply means that, while the self-induction and capacity of the line and load raises the voltage, much as a water ram in a pipe line raises the pressure, it at the same time throws the current out of phase with that voltage, and the real power is that obtained by the multiplication of the apparent volt-amperes by the cosine of the angle of lag introduced. It is therefore only possible to read the power indications of a Watt-meter, which instrument takes account of this angle while the volt and ampere meter readings which are used to determine direct current power are not reliable for the alternating. This increase of voltage may under certain conditions become so serious as to endanger the insulation of line and apparatus. In most cases it is advisable to reduce the induction as much as possible, and to effect this the wires on opposite sides of the circuit are strung as closely together as is consistent with safety, and several wires of equivalent cross section used rather than a smaller number of larger area. To do away with unbalancing of the phases of the system, the circuits should be strung symmetrically, which is effected in the case of two phase lines by placing the going and returning wires of each phase on the opposite ends of the diagonal of a square, and in three phase lines by stringing the three conductors at the corners of an equilateral triangle. As lightning may cause trouble, not only by direct stroke, but by the accumulation of static electricity upon the lines, means must be provided for getting rid of it safely. To this end, guard lines of barbed wire are strung above the circuits, and these are grounded at frequent intervals.

The apparatus in the generating section of the plant consists of the water wheels, generator, raising transformers and switchboard apparatus. Regarding the latter two, the same remarks apply as were made regarding similar apparatus in the distributing station. As to the generators, their size is usually limited by the power of the water wheel units, and their speed by the wheel speed unless gearing be used. The usual method of attacking the question with direct connected units is to arrange for as powerful wheels as is possible consistent with having the proper size units to handle the load properly, and designing the generators properly to suit the wheels as regards size and speed. Vertical turbines with the rotating part of the generator revolving in a horizontal plane are usual, but, in several recent plants, horizontal turbines are used direct connected to the generators, which in that case are below the crest of the dam and above the tail-race by an amount determined by the height of the draft tube. The first system introduces footstep bearings, which are always more or less objectionable, but removes the delicate armature windings from chance of damage by water. The second places the generator at the mercy of water-tight bulkheads and stuffing-boxes. As to the voltage to be generated upon the machines, if raising transformers are used, this is of little consequence unless from a machine designer's point of view, as the transformers will have equal efficiency at any ratio of transformation. When the transmission voltage is not dangerously high, it is of course preferable to do away with these transformers, and generate directly on the machine. In deciding this point it must be kept in mind that the failure of a transformer through the breaking down of insulation is a much less serious matter than that of a generator, which is less likely to occur when that apparatus is of low voltage. Owing, however, to improved types of generators, we may expect to see raising transformers dispensed with in many cases where they would have been deemed indispensable with older types.

In specifications drawn up for the generating apparatus, the following points are strongly insisted upon: (1) That the heating of any part shall not exceed a certain specified temperature after a certain length of run at full load and an additional time at a certain specified overload. (2) That the efficiency at full load, three quarters, one half, and one quarter loads, shall be guaranteed by the tenderer and proved by test. (3) That the regulation of the generator shall be within a certain per cent. at full non-inductive load. (4) That the insulation of any part of the machine shall not break down under a specified voltage which is high enough to allow of a good factor of safety over the normal pressure. Although it is impossible to specify limits for these requirements which will suit every case, it may be said generally that the allowable increase of temperatures for large generators ranges from thirty to forty degrees centigrade. The full load efficiency from ninety-four to ninety-six per cent. The regulation depends upon whether the machine is compound wound or not. In the former case the regulation may be anything for which the compounding is set, and in the latter from three to ten per cent. The test voltage applied ranges from three to ten times the operative, the former factor for high voltage machines, the latter for lower voltages. The modern generator being either of the inductor, or revolving field type, in which the high potential armature windings are stationary, lends itself to high voltage generation, as the insulation spaces may be increased largely without rendering the machines unwieldy, for the reason that the armature wires are distributed over the outside ring where space is more abundant, and the vibration of running, which abrades, and finally breaks down the insulation on the older revolving armature types is largely absent in the newer machines.

(To be continued.)

WANTED—Position by stationary engineer, second-class certificate of the Ontario Association. Ten years' experience; strictly temperate. Apply "NORWOOD," care Canadian Engineer.

PERSONAL—Will Mr. H. Weir, who formerly resided at 42 St Alexander St., Montreal, kindly communicate with us. Any friend of Mr. Weir knowing his present address will oblige by calling his attention to this advertisement. BIGGAR, SAMUEL & CO., Publishers Canadian Engineer, Fraser Building, Montreal.

TENDERS FOR BRIDGE CONSTRUCTION

OFFICE OF THE QUEBEC BRIDGE CO., LIMITED

Sealed proposals for the construction of a combined Railway and Highway Bridge across the River St. Lawrence, near Quebec, will be received by the undersigned until noon, Monday, January 2nd, 1899.

Forms of tender, with circular of conditions, specifications, &c., can be had on application to the undersigned.

The company does not bind itself to accept the lowest or any tender.

ULRIC BARTHE, Secretary

Quebec, September 24th, 1898.

The Canadian Engineer

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MASONRY PIER MOVED BY ICE AND REPLACED.*

BY R. W. LEONARD, M. CAN. SOC. C.E.

During the winter of 1895-96 the masonry for the four spans of the bridge which carries the St. Lawrence and Adirondack Railway (since leased to the New York Central and Hudson River Railway) over the Chateauguay River, Province of Quebec, was constructed.

The river at the crossing is 600 feet wide, and is spanned by four through steel spans of 150 feet each. The river is from 8 to 12 feet deep at low water, the bottom being clay, with some gravel in places and a few scattered boulders.

The abutments were built on shore; 75 piles were driven through the ice for each pier, and cut off by hand with a cross-cut saw carried in a light, stiff hardwood frame, just above mud-line. Field stone were filled in between piles to a level with top. A caisson was framed with double 12 x 12 bottom caulked, and double plank sides with tar paper between the planks, and sunk in place by the masonry as it was built inside. Rip-rap was finally placed round the piers to a height above the timber platform to prevent scour.

The abutments and two westerly piers were completed and two spans erected and resting on them. The easterly pier was just erected and two men were pointing the masonry on a warm spring day, when the ice shoved in the river and went out very suddenly. The winter had been exceptionally severe, with but little snow-fall, and the ice was strong, especially where it had been worked on all winter close to the bridge, at which place it was about three feet in thickness. A very large field of ice drifted down from the basin, lodged against the west shore and the westerly piers and swung against the unfinished pier, striking it obliquely on the westward side of the ice-breaker.

The field of ice was immediately broken in pieces by the piers and passed on, apparently doing no damage. On close inspection and measurement, however, I found that the easterly pier had moved out of position.

To replace the pier I built a crib as shown on the plan, sunk it in place, drove a row of piles behind it, loaded the top of crib with stones, and set four hydraulic 50-ton jacks between crib and pier. These moved the pier two inches, and the bottom of the platform then stuck on the head of the corner pile from which it had been pushed. A diver, who had been employed to remove the rip-rap around the pier and to examine the foundation, was instructed to cut this pile down half an inch, and a second and successful attempt was made with three jacks, two of 100 tons and one of 50 tons capacity. The pier was moved back to its proper position without showing the slightest crack in the pointing, or any other damage.

Additional rip rap was placed around the pier, the crib removed and piles cut off close, at a total cost of about $800.

There has been no further difficulty.

The weight of the pier is about...960,000 lbs. in air
Hemlock platform " ..... 50,000 "

1,010,000 " or 500 tons

Plan shows level of water when ice moved, and level of water at time when pier was replaced.

The facts may be interesting to Canadian engineers, as they show the dimensions of the masonry and the conditions existing in the case of a pier that just moved, and the force necessary to shift it on its foundation.

WEIGHTS ON FOUNDATION WHEN PIER WAS PUSHED BY ICE.

S.G. Limestone = 2.7
S.G. Hemlock = 0.7 say:
5/6 of masonry submerged say, therefore

Weight of pier at H.W.M. would be $\frac{960,000}{6}$ 160,000 lbs.

$+ \frac{17}{27} \times \frac{5}{6} \times 960,000$ 503,700

663,700

Less flotation of platform 3/10 × 50,000. 15,000

Net weight of east pier when pushed by ice 648,700

150-foot span weighed about 350,000 lbs., therefore weight on piers not moved would be

Centre pier $648,700 \times \frac{350,000}{2}$ 823,700

West pier $648,700 \times 350,000$ 990,780

WEIGHT ON FOUNDATION WHEN EAST PIER WAS REPLACED.

$\frac{1}{2}$ masonry submerged.

weight of pier would be $\frac{1}{2} \times 960,000$ 480,000 lbs.

$+ \frac{17}{27} \times \frac{1}{2} \times 960,000$ 302,222

782,222

Say 391 tons.

*From a paper read before the Canadian Society of Civil Engineers.

Moved by 4 jacks of 50 tons, 200 tons.
Approx. co-efficient of friction, say ½ to 0.5 about.
Moved by 2 jacks of 100 tons and 1 of 50 tons, 250 tons.
Approx. co-efficient of friction 0.65.

Taking co-efficient of friction at ½, the thrust of the ice was about $\frac{648{,}000}{2}$ or 166 tons, or about 11 tons per square foot considering the ice three feet thick and striking the pier obliquely on a width of 5 feet.

THE STORAGE BATTERY FOR RAILWAY TRACTION.

As early as 1880, experiments in connection with storage battery traction were made in London, Paris, Brussels, Birmingham, Hamburg, New York, New Orleans, Washington and Dubuque. The short life of the batteries and the enormous expense of renewing the positive plates, resulted in failure, the battery quickly deteriorating under the care of the ordinary railway employees. In theory, as the Street Railway Review remarks, the storage battery did present many ideal conditions. "It provided a self-contained motor car with no outside accessories, as trolley lines, feeders, bonds for the transmission of the current. The electric current could be generated in a station free from overloads and troublesome peaks, at certain times of the day, and thus the station need only be of minimum capacity for the work required."

In Europe.

E. A. Ziffer, C.E., of Vienna, Austria, president of a local street railway, in an address before the International Street Railway Association, which met in Geneva last summer, reviewed all the present systems of mechanical traction, and sums up his conclusions in reference to the storage battery system in these words: "Accumulator traction, which might be considered the ideal, is still in the experimental stage, in spite of the good results already obtained. It continues to be a subject of great interest, and has a hopeful future." The weight of the batteries has always been a detriment to the working of the storage battery system of traction. Mr. Ziffer gives the weight of the battery, with all accessories, capable of operating a double truck car, weighing 12½ tons, English, for a distance of 9½ to 12½ miles, as 1.2 tons, English. The Ribbe Accumulator, which has been tested on one of the lines in Berlin, is lighter than the usual type, the weight for a capacity of 300 amperes-hours at a pressure of 260 volts, being 3.4 English tons. Even this is very much heavier than the batteries which are being made in Canada, which were mentioned and illustrated in our October number; but notwithstanding the enormous weights of the European and American batteries, very satisfactory progress has been made on both continents. The Wurtemburg State railways are making an important test of the value of storage batteries for traction purposes, and have put in operation near Stuttgart, on a line 14½ miles long, a storage battery car seating 48 passengers, the battery having 188 cells, weight, 5.8 tons (weights are stated in English tons), and giving a capacity of 16,000 watt hours. In a test made in September, 1897, with this car, which weighed, with passengers, 28.75 tons, the current consumption was from 29.34 to 30.45 watt hours per ton mile, at an average speed of 19 miles per hour—a very satisfactory result. Similar experiments are being carried on in Belgium on the Brussels-Liege line. In Paris, 35 storage battery cars are in use, the batteries alone weighing 3.5 tons out of a total of 14 tons per car, loaded with 52 passengers. The time of charging the batteries is from 8 to 12 minutes. The battery contains 54 ampere-hours. The Ostend Tramway is operated by accumulators.

Since March, 1896, two accumulator cars have been in use on the narrow gauge lines near Darmstadt. The cars carry 32 passengers, and weigh, without passengers, 8.1 tons, of which the battery weighs 2.3 tons. The plates are of the Plante type, and have a capacity of 30 ampere-hours, with 4.20 volts, average E.M.F. From April, 1896, to August, 1898, these cars made an average of 62.14 miles per day, and the consumption of current has been 645 watts per car mile. Up to the spring of 1897, no trouble had been experienced with these cars, therefore the Railway Commissioners decided to install some larger cars, which will soon be in operation. In May, 1897, two 24.4 ton motor cars were put in operation on the Ludwigshafen, Neustadt & Worms lines, having a total length of 32.3 miles. Each car weighs 11 tons, battery, 9.3 tons; motor and accessories, 4.1 tons. A single charge of the battery makes the round trip at an average speed of 15½ miles per hour. Each car carries 36 passengers, and draws one trailer carrying 50 passengers. The cost of operation, including wages of conductor and motorman, fuel, oil and waste, is 28.65 cents per train mile. On the Frankfort-on-Main tramway, the battery weighs 2 tons, and the empty car, excluding the battery, weighs 6 tons The battery is stored in 4 or 5 minutes, and this charge lasts for short round trip of half an hour. In Munich, where the overhead trolley is not allowed, a storage battery locomotive is about to be put in operation, to draw a trail car. On the Berlin-Charlottenburg line the battery consists of 180 cells of 260 ampere hour capacity. The car body and truck weigh 19,316 lbs., battery, 15,048 lbs.; 2 motors, with gears, 3,300 lbs.; total, 37,664 lbs. When loaded with 42 passengers, total weight is 43,000 lbs. With the battery on this car it makes ten round trips a day, covering 90 miles a day, at an average speed of 9.3 miles an hour, but 14.25 miles per hour is the best performance.

While the overhead trolley system is the one most generally adopted in Europe and America, and in the opinion of Mr. Ziffer is the most simple, the most economical, and the one which has given in practice the best results up to the present time, he concedes that "It is a very difficult thing to say which among all the mechanical systems of traction is the most desirable from an engineering and economical standpoint. It is necessary to take up each condition individually, and weigh carefully all the relative circumstances in construction and operation."

The list of systems is now rather extensive, and may be grouped as follows: Steam—Rowan, Serpollet, Clark systems; Stored Steam Locomotives—Lamm-Francq & Dodd systems; Compressed Air—Merkarski, Popp-Conti, and American Air Power Company's system; Gas Benzine and Petroleum Motors—Lubrig, Daimler and Diesel systems. There are, also, the cable system, the overhead trolley, the electric conduit, the surface contact, the third rail, and the mixed electric systems—combination of accumulators, and overhead,

In America.

During the past five years, experiments in accumulator traction were made on a commercial scale in New York, under the auspices of the Julien Company, which for a considerable time operated 10 or 12 cars on the 4th avenue road. Trials more or less successful were also made in Philadelphia, New Orleans, and the other American cities, above mentioned. The most successful storage battery road in operation in the United States is that of the Chicago Electric Traction Company, which runs a line about 20 miles long between Chicago and Englewood. There are no stations on the line along the route, the entire line being within the city limits, although the most of it is through only sparsely-settled territory. The cars are required to stop at all street crossings to let off and take on passengers. The batteries weigh 3½ tons per car, each battery consisting of 72 cells, and having a capacity of 400 ampere hours, while the weight of car, equipped with batteries ready for use, is 16 tons. The weight of rail is 80 lbs. Eight regular cars run on week days, but on Sundays and holidays as many as 40 are used, including trailers. Owing to the weight of the cars, they cannot be started and stopped as quickly as a trolley car, which only weighs 8 or 9 tons; but this inability results in more care on the part of the motormen, who always pass vehicles with the power shut off, giving them a better opportunity to use the brakes. The "accident account" is surprisingly low, only two-thirds of one per cent. of the gross receipts, while the usual rate for a suburban trolley line is 2 per cent. Motormen are trained to "coast" as much as possible, the weight of the cars enabling them to coast faster and further than would be otherwise the case. Snow storms have been successfully handled with but one plough, weighing 22 tons, and one sweeper, weighing 26 tons, for 26 miles of track. The manager, E. R. Gilbert, who was formerly connected with trolley lines, reports that he got more work out of these appliances than he had ever seen accomplished with machines operated by trolley. In one case they cut through a drift 7 feet high, and several hundred feet long, by "bucking" the drifts with a plough. Cars have been run 40 miles on one charge, but the conditions for such a long run are so often unfavorable that it has been found advisable to change the batteries every half trip of 11 miles, the power-plant being located in the middle of the system. By doing this, cars are able to carry trailers and make the trip under all conditions. Passengers do not seem to mind in the least the slight delay caused by changing the batteries, which takes only 1¼ minutes. The road-bed is nearly level, except one hill about 300 feet long with a grade of 9½ per cent. With a dry rail the cars easily climb the hill without assistance. In one instance, two loaded trailers were hauled, a counter-weight system being provided to prevent accidents and slipping.

"Our cars average over 200 miles per day," Mr. Gilbert says, "at an average speed of 12 miles per hour. Passengers, one and all, agree that riding on them is much more pleasant than on any other system, as the cars ride very smoothly, owing to their weight, without the unpleasant noise of the trolley or the jerking of the cable system. The advertising resulting from these conditions is worth considering." An element of importance is the fact that the whole line cannot be shut down at once, as all cars are independent of each other. There is no necessity for a wrecking wagon, as a wrecking car can always be sent out, as on a steam road. The steam plant (power-house) is also more independent than on a trolley road, as it can be shut down two or three hours without interfering with the service in the least. Current for lights in the office, barn and power-house is taken direct from the batteries, therefore there is no necessity to run the plant all night. It is closed down at 11 p.m., although the last car does not reach the barn until nearly 1.30 a.m. The load on the engines and dynamos is always constant.

Wear and tear on trucks, wheels, roadbed, and special work is very much heavier than on a trolley system, because of the great weight of the cars. We use an 80-lb. girder rail and all crossings, etc., are made extra heavy, but even then the cost of maintenance is very great. The depreciation of the batteries is 2c. per car mile, as against the depreciation of overhead work and rail bonding on a trolley road, which would amount for similar mileage to about $4,325 per year. Operating expenses average 8 2-3c. per car mile, comparing favorably even now with those on trolley systems, but the difference will be greatly in favor of the battery line, as the service on the latter grows towards the capacity for which the plant was built. "I see no reason," Mr. Gilbert adds, "why a storage battery system under fair conditions cannot be operated fully as cheaply as a trolley line." Taking a basis of 20 cars, and the mileage of the Englewood road, the difference in cost of construction of that particular road would be only about $25,000 in favor of the trolley system. To offset this slightly greater expense is the unquestionable advantage of having no overhead work of any kind to mar the appearance of the streets through which the road runs, or to add the element of danger to the public from live wires or electrolysis.

The numerous facts and data cited by Mr. Ziffer, as to the installation and operation of various systems in different parts of Europe, show that the accumulator, or storage battery, stands well the test of comparison. The following table is very interesting and instructive in this connection. It is given by Mr. Gofferneaux in his work on "Mechanical Traction for Tramways," and is a theoretical comparison of the cost of the different systems, including 10 per cent. fund for depreciation on the capital invested, and based upon an annual traffic of 621,382 car miles. The figures are in cents per car mile.

System of Traction.	Operation.	Depreciation.	Total.
	c.	c.	c.
Serpollet (steam)	9.7	3.5	13.2
Rowan (steam)	11.3	3.5	14.8
Electric accumulators	10.9	4.2	15.1
Trolleys	10.0	5.5	15.5
Gas motor	13.9	3.5	17.4
Compressed air	13.55	4.85	18.4

It will thus be seen that in point of economy, electric accumulators are superior to the popular trolley, while compressed air is at the foot of the list.

Reduction in the weight of batteries would materially lessen the cost of construction in a storage battery railway, as lighter cars, rails, and equipment generally could be employed. In competition with the trolley, the construction of which costs per single mile, according to Mr. Pearson, of New York, $16,650,

the storage battery ought to have a good fighting chance on the trolley's own ground. We would suggest to the engineers whether it might not be possible to devise a simpler and lighter system of construction, taking into consideration the particular necessities of the case, that will fill the conditions required in this wooded country, in the more sparsely-settled districts, and in connection with mining and lumbering camps.

—The report on the gold deposits in the Province of Quebec just issued by J. Obalski, the Government mining engineer, which bears date June, 1898, is a pamphlet of some hundred pages which gives a very interesting historical outline of the gold mines of the Chaudiere valley, which are now the property of the De Lery family, being part of the famous seignorial grants of Rigaud-Vaudreuil of 1736, to which the gold rights were added in 1846, and comprise 71,000 acres divided into thirteen mining sections.

—The report of the street commissioner of St. Louis, A. N. Milner, is an interesting and beautifully illustrated publication, which shows the present position and progress of the city. We learn that the population is now 651,821, and the bonded debt is $19,959,278. The city bridges have cost, with approaches, $1,513,618. The macadam of the improved streets costs $16,500 per mile in St. Louis, but the curbs and gutters are either of brick laid on concrete or granotoid, which of course adds enormously to the wearing and serviceable qualities of the road-bed. One-half the lanes in the city have been paved at a cost varying from $30,500 per mile for granite blocks to $12,000 per mile for limestone blocks.

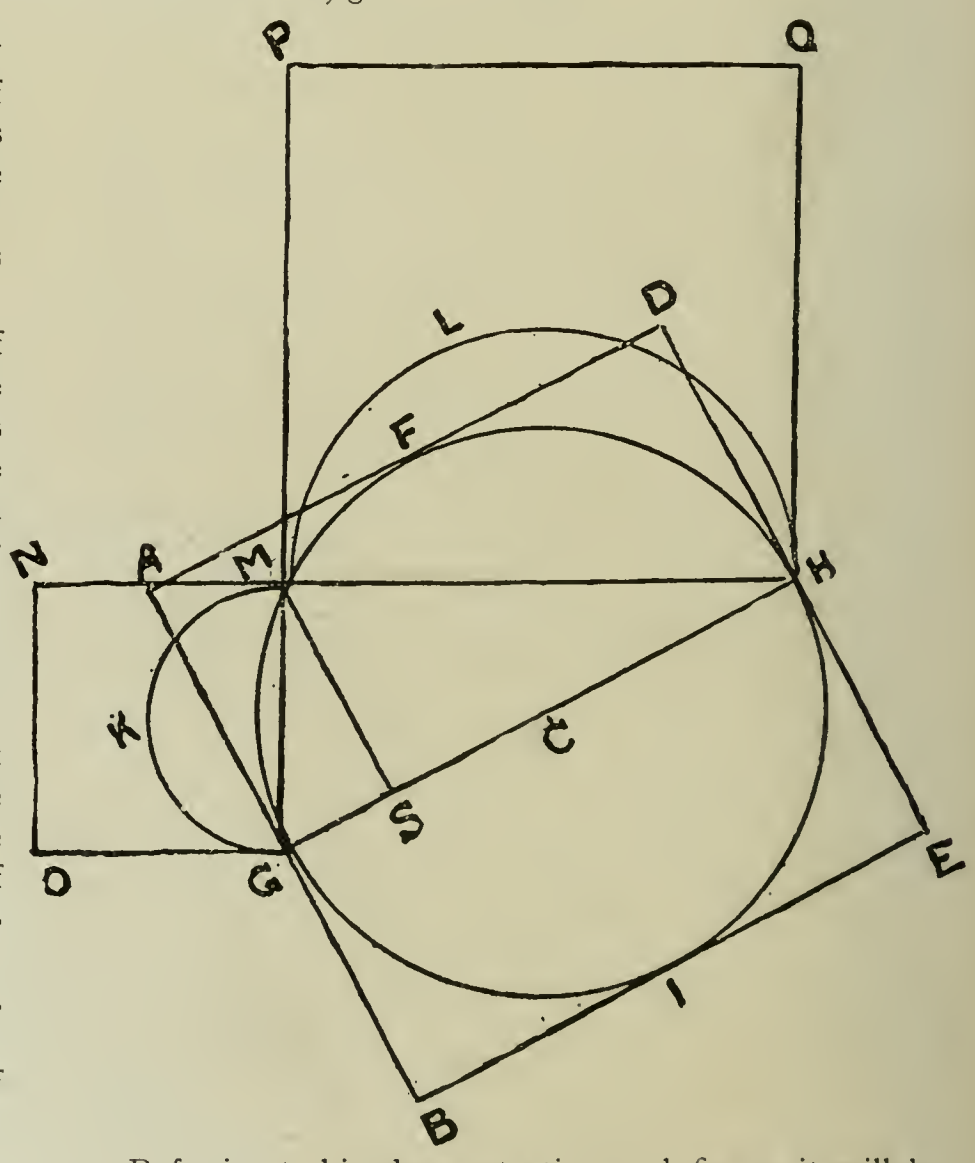
—The report made by C. H. Rust, city engineer of Toronto, on the subject of sewage disposal with reference to the present undesirable conditions in Toronto, contains a great deal of information in a concise form. But we think some of the methods of disposal might have been more fully discussed, nor do we quite see that the matter narrows itself down to intermittent filtration at a first cost of $1,730,000 and an annual charge of $70,000 ; or precipitation works at a first cost of $1,540,000 and an annual charge of $105,000, as the Toronto engineer concludes. Any conclusion in the matter of sewage disposal is most unwise until the Royal Commission appointed by the Imperial Government has made its report, which will be prepared after examining the promoters and operators of all known systems upon oath. Any town which goes to the expense of asking its own engineer to prepare a report on the subject in the meantime is merely wasting its money, because no engineer can examine all known systems himself, nor can he ask questions which are sure of truthful answers from the promoters, because they are not upon oath.

TO SQUARE THE CIRCLE.

The following criticism of the recently published solution of the old problem has been written for THE CANADIAN ENGINEER by one of the most able mathematicians in Canada, one who is considered an authority on mathematics and kindred subjects, throughout the continent :—

E. Stone Wiggins, B.A., M.D., LL.D., of the civil service, Ottawa, is to the front with what he believes to be a successful squaring of the circle. Unhappily for him he is no more successful than others who in modern times have battered what they were pleased to call their brains against this problem. Mr. Wiggins says there were four problems for which the ancient mathematicians in vain sought solutions : (1) Squaring the circle ; (2) trisecting any angle ; (3) duplicating the cube ; and (4) finding two geometrical means between two given straight lines. Had "Professor" Wiggins known more of mathematics than he does, he would have been aware that (3) and (4) are one and the same problem. And again, had he had a slight knowledge of mathematics he would have known that the accuracy of tables of lines and tangents does not depend on the size of any circle to which the angle may be conceived as having reference. The "Professor" seems to think the numerical values of the trigonometrical ratios are determined by measurement with a carpenter's rule.

But to come to the squaring of the circle. It would be too dreary a labor to go through his reasoning and point out where the fallacies creep in. Fortunately there is a more expeditious way of disposing of the "Professor" and his demonstration. The ratio of the circumference of a circle to its diameter, 3.14159...., has been found approximately with absolute certainty. There is nothing more certain in science than that this is the approximate value of this geometrical constant. It has been determined in countless different ways, and always with the same result. It will therefore be sufficient for us to examine what value Mr. Wiggins' construction (for a square equal in area to a circle) gives to this ratio.



Referring to his demonstration and figure, it will be seen he claims that the square on MH is equal in area to the circle. But

$$MH^2 = \frac{GH^4}{AH^2} = \frac{16\,(\text{radius})^4}{5\,(\text{radius})^2}$$

$$= 3.2\,(\text{radius})^2$$

and area of any circle = (ratio of circumference to diameter) × (radius)^2. Hence if, as the Ottawa philosopher claims, MH^2 = area of circle, we shall have ratio of circumference to diameter of a circle = 3.2, instead of 3.14159...., which latter it certainly is.

If it be urged as an objection to the preceding, that it shows Mr. Wiggins to be wrong, but does not show where he is wrong, the reply is that it disposes of his pretentiousness in an expeditious manner, and that in going thus far we have accorded to him more consideration than his exhibition of ignorance is entitled to.

We append the demonstration of the problem of squaring the circle which E. Stone Wiggins, B.A., M.D., LL.D., Ottawa, has recently published. On another page will be found a criticism of the demonstration:

CONSTRUCTIONS AND DEMONSTRATIONS:

Let F G I H be any given circle having its diameter G C H. About this circle describe the square A B E D touching it at the points F G I H. Join A H, cutting the circle at M. The square on M H is equal to the given circle F G I H.

Because G H is double G A, and the triangle M G H is similar to the triangle G A H, therefore, the side M H is double M G. Hence the triangle M G H equals the square on M G.

On M G describe the square M G O N which will be spoken of as the square on M G. On M H describe the square M H Q P which will be spoken of as the square on M H. Also, on M G, as diameter, describe the circle M K G which will be spoken of as the inscribed circle of the square on M G, or the circle on M G. Similarly describe on M H as diameter the circle M L H which will be spoken of as the inscribed circle of the square on M H, or the circle on M H.

It is evident that some straight line may be drawn from the point H to meet the arc G F, the square on which will equal the given circle. Let any line M H be by hypothesis this straight line.

Now, since the square on M H—the same construction being made—is equal to the given circle F G I H, it is equal to the two circles on M G and M H because these two circles equal together the given circle. Therefore, the circle on M G equals the rim of the circle on M H, that is the part of the square M H Q P which is outside its inscribed circle.

From the point M let fall the perpendicular M S upon G H.

Now, the circle on M H is to the cricle on M G as the triangle S M H is to the triangle S G M for they are similar figures described on M H and M G, the sides of the rightangled triangle M G H. Therefore, if the triangle S M H were formed into a circle the triangle S G M would become its rim in the same way that if the square on M H were formed into the given circle—for by hypothesis it is equal to it—the square on M G would become its rim. Hence, the rightangled triangle M G H must be the only triangle that can be described in the semi-circle G F H which is so divided by its perpendicular M S, that its parts, the triangles S M H and S G M, will have the same relation to each other as the circle has to its rim.

To square the circle geometrically, it will be necessary:

1. To divide the given circle into two circles, having the same relation to each other as the circle has to its rim.

2. To divide the rim of the given circle into two parts, having the same relation to each other as the circle has to its rim.

Then the smaller circle of the former pair will equal the larger figure of the smaller pair.

To illustrate from the figure: If the square on M H equals the given circle then the latter is divided into two circles, the circle on M H and the circle on M G, which are to each other as the circle to its rim; also if the triangle M G H is equal to the rim of the given circle, it is likewise divided into two parts by its perpendicular M S, the triangle M S H and the triangle M S G, which are to each other as the circle is to its rim. Or to express it in proportionals to meet the above two conditions, the circle on M H is to the circle on M G, as the triangle M S H is to the triangle M S G, in which the triangle M S H is equal to the circle on M G. That is, the circle on M G equals the rim of the circle on M H.

The reason the square on M H is equal to the given circle is that it is made up of the circle on M H and some regular figure also described on M H, and, which happens to be made by the construction, equal to the rim of "the circle on M H."

It will be noticed that the construction transfers the circle on M G from the left side to the right, forming the rim of the circle on M H, while it is represented on the left by the triangle S G M, which is really described like itself on M G.

Since the square on M H is by hypothesis equal to the given circle, it is the same multiple of the triangle M G H, which is described in the semi-circle of the given circle, as the circle on M G is of the triangle S G W, which is described on its semi-circle, because these are similar triangles. But the rim of the circle on M H being equal to the circle on M G, it is also the same multiple of the triangle S G M, demonstrating that the triangle S G M or its multiple is transferred from left to right and added into the square on M H. The rim of the circle on M H being, as already shown, equal to the circle on M G, it must be that it is the same multiple of the triangle S G M, that the triangle S M H is of the same triangle. That is, the triangle S M H is equal to the rim of the circle on M H, and therefore equal to the circle on M G, for they are both described on the side M H. The triangle S G M must then be equal to the rim of the circle on M G, and the triangle M G H must equal the rim of the given circle.

Because the square on M G may be either greater or less than the triangle M G H, according to the position of the point M in the arc G F, let the triangle M S H be by hypothesis equal to the circle M G. Now the circle on M G is to the triangle S G M, as the circle on M H is to the triangle M S H. Therefore the given circle (that is the two circles), is to the triangle M G H, as the circle on M G is to the triangle S G M, but the circle on M H and the triangle S M H are equal to the given circle. Therefore they are together to the triangle M G H, as the circle on M G is to the triangle S G M. Hence the circle on M H plus the triangle S M H, are to the circle on M G as the triangle M G H is to the triangle S G M.

But in the construction, when the square on M H was by hypothesis equal to the given circle, the latter was the same multiple of the triangle M G H, as the circle on M G was of the triangle S G M, and this would be true whatever be the position of M in the arc G F. When, therefore, the square on M H becomes equal to the given circle, it is the same multiple of the triangle M G H, as the circle on M G is of the triangle S G H. Hence the square on M H is to the circle on M G as the triangle M G H is to the triangle S G M, the same as in the previous construction. They must then be of the same construction. Therefore, when the square on M H is equal to the given circle the triangle S M H must be equal to the circle on M G. Then the triangle S G M is the rim of the circle on M G, and the whole triangle M G H is equal to the square on M G. That is, the side M H is double the side M G, as in the original construction. The square M H Q P in the original construction is therefore equal to the given circle F G I H.

The two conditions mentioned are here fulfilled for the triangle M G H, the rim of the given circle is divided into two parts, related to each other, as the circle to its rim. The given circle has also been similarly divided and the larger of the former equals the smaller of the latter.

That the circle on M G is transferred from left to right, forming the rim of the circle of the square that equals the given circle, or, rather that the rim of the circle in the square on M H is to the triangle S G M as the circle is to its rim; also, that by assuming that the triangle S M H is equal to the circle on M G, the regular figure on M H is increased by the circle on M G, produce H D to meet M P produced in the point V. Now, because the triangle S M H on the longer side of the triangle S G M is equal to the circle on its hypotenuse M G, so also must the similar triangle M H V, described on the longer side of the triangle M G H, be equal to the circle on its hypotenuse G H, that is, the given circle. Now, it will be seen that if a perpendicular M W be drawn to the base, H V, that the triangle H M V will be divided into two triangles, W M V and M W H, and these triangles are to each other as the triangle M S H is to the triangle M S G, that is, as the circle on M H is to the circle on M G. But the triangle M W H equals the triangle M S H, for they are similar and have the side M H in common, and the latter is equal to the circle on M G, therefore, the two triangles M W V and M W H are equal to the two circles each to each. The triangle M H V, therefore, must be equal to the square on M H in the same way that the circle on M H together with the triangle S M H are equal to the square on M H which equals the given circle.

Again, let the square on M H be equal to the given circle, and in the semi-circle M L H describe the rightangled triangle M L H equal to the rim of the circle on M H. Describe, also, the rightangled triangle M K G in the semi-circle M K G equal to the rim of the circle on M G. These triangles should be described on the upper side of M H and M G and on a separate sheet, as they would if drawn in the cut here given render it difficult and obscure. These should be similar to the triangles

S M H and S G M, the real triangles, which are turned down to form the triangle, M G H. Produce H L to meet M P in R. Since the rightangled triangle in the given circle to be equal to the rim of the given circle must be similar to the triangle M L H and equal to these two triangles, and must also be described on its diameter, G H, therefore, the base, H R, must equal G H. Hence the triangle, M G H, must be the rim of the given circle.

Lastly, it will be observed that as the apex M, of the triangle M G H, is moved along the arc G F, the area of the lunes G K M and M L H will increase or diminish as M approaches or recedes from F. These lunes, known as the Lunes of Hipparchus, are always together equal to the triangle M G H. Now there must be some point in the arc G F, where M may be placed so that the quadrilateral P G H Q, will be equal to the irregular circle G K L H I (made up of the given circle and the lunes), when the square H Q P M will, of course, be equal to the given circle. This can only happen when the lunes are equal to the square on M G. It will be observed that the lune G K M is always a part of this square, and that it is only when the remainder, after it is deducted, is equal to the larger lune, that the two lunes can form a square. But when the square on M H is equal to the given circle, the triangle M G H, to which they are equal will, as already demonstrated, form a square. But in the original construction the triangle M G H, to which the two lunes were equal, was equal to the square on M G, showing that the two lunes formed this square. Hence the latter construction must be the same as the original and the square on M H in the original construction is equal to the given circle.

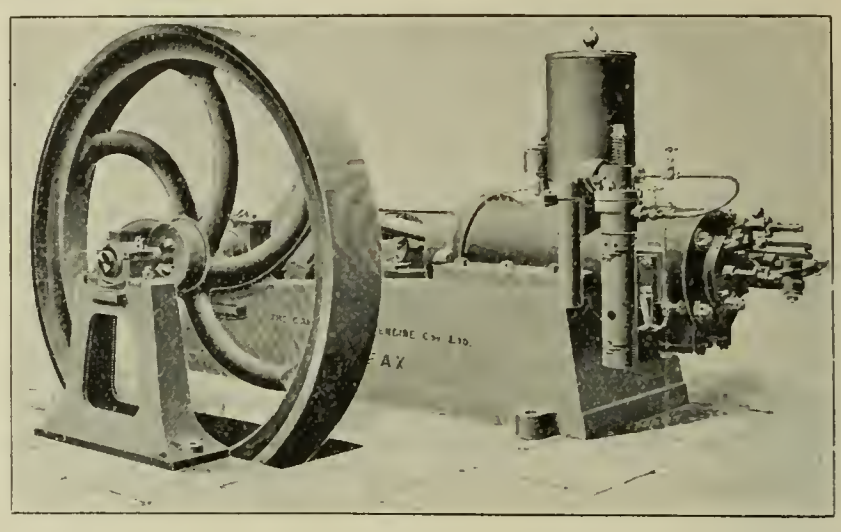
LOVE PUT OUT THE LIGHT.

The North Shore Power Co., which is supplying electricity for the city of Three Rivers, is generating it at Batiscan Chute and stepping it up to 12,000 volts for the purpose of a 16 mile transmission. A few evenings ago just as the dusk was coming on and the heavy load beginning to show on the ampere meters, the circuit breakers flew, the fuses blew and the lights were out. This lasted for perhaps ten minutes when the lights again started up and ran satisfactorily. The day following, the electrician naturally investigated to see what caused the trouble, and he found that a window had been broken in the sub-station at Three Rivers, and that some of Jean Baptiste's chickens had sought a roost on the bare copper wire, and as Chanticleer kissed Biddie "good-night" it completed the circuit, electrocuted the lovers and put the lights out.

This, perhaps, is one of the most uncommon short circuits or reasons for trouble that has occurred in Canada, and is a pointer for other electricians who may have power houses with broken window panes.

THE "CAMPBELL" ELECTRIC LIGHTING TYPE OIL ENGINE.

The Campbell Gas Engine Co., Ltd., Halifax, Eng., the largest maker of oil and gas engines in the world, having been called upon to supply several of its oil engines for electric lighting purposes, has decided a short time ago to introduce an oil engine specially for this work, which has proved a great success. To absorb the irregularities in speed due to the peculiarities of the "Otto Cycle," on which all oil engines are constructed, and the irregularity caused by changes in load, the Campbell Company states, the special engine is fitted with one heavy fly-wheel of large diameter. The crank-shaft is provided with a third or outer bearing, so preventing any undue strain being put on the shaft, which would be the case if the fly-wheel was unsupported or over-hung. The moving parts of the engine are balanced as nearly as possible by weights fixed rigidly on the crank webs. Automatic lubrication is provided for the crank pin, so that long runs can be made without stoppages for oil purposes. The engine is also provided with a special governor, driven direct from the crank-shaft of the engine, independent of other gearing by means of skew-gear wheels with machine-cut teeth. Every detail of the engine has been carefully studied to fit it for exacting and continuous work. It is provided with a special splash cover over the crank, and oil trays are fitted to the bed to catch the waste oil. From experiments made with these engines the makers state that variation in speed does not exceed two per cent., so that these engines can be relied upon for the steady running of incandescent lamps.



THE "CAMPBELL" ELECTRIC LIGHTING TYPE OIL ENGINE.

"A large installation has recently been put into the New Palace Theatre just erected at Plymouth, Eng.," says an article in The Electrical Review of October 28th, 1898. "The installation consists of 1,200 incandescent lamps and six Jandus arc lamps. On the ground floor are fixed four 25-30 brake h.p. gas engines made by the Campbell Gas Engine Company, Ltd., Halifax. These engines have been specially designed for the driving of dynamos, with governors actuated direct from the crankshaft. Each engine has one large, heavy fly-wheel, weighing about two tons, and measuring 6 feet 6 inches in diameter. The engines are all arranged with their fly-wheels nearest the walls of engine room to allow plenty of room for the man controlling the plant. Each engine is fitted with a patent self starter. All the four engines can be got up to full speed within a quarter of an hour. The cooling of the cylinders is done from three rectangular tanks, having a total capacity of 3,600 gallons. A large main feed to the engines and one common return, to which each engine is connected, ensure a perfect cooling arrangement. The difficulty of space has been well got over in the arrangement of the water tanks. The exhaust of each engine is carried to the top of the theatre roof, about 60 feet high, with a 3½-inch pipe, and passed through an exhaust box and silencer, the noise from the exhaust being effectually silenced. These engines drive four shunt wound dynamos erected on the first floor immediately over the engine room, the arrangement of cross driving allowing 18 feet between engine and dynamo centres. The dynamos are driven by special laminated leather belting. Three are wound for an output of 145 amperes at 110 volts, and the fourth for 100 amperes at 150 volts. The average load of the installation is 500 amperes per hour for four hours at 110 volts. Therefore 55 x 4 equals 220 units per night; 220 x 6 equals 1,320 units per week. The gas for the four 25 brake h.p. gas engines passes through a 400 light meter; the gas consumption per night averages 7,000 cubic feet, and the Plymouth Gas Company's charge is at the rate of 1s. 9d. per 1,000; 7,000 at 1s. 9d. per 1,000 equals 12s. 3d. per night, or £3 13s. 6d. per week. The cost of production is therefore:

42,000 cubic feet of gas per week at 1s. 9d. per 1,000	£3 13s. 6d.
Gas engine man's attendance at £1 5s. 6d. per week	1 5s. 6d.
One dynamo attendant at £1 2s. 6d. per week	1 2s. 6d.
Oil, waste and engine sundries	12s. 6d.
For 1,320 units	£6 14s. 0d.

From the above figures it will be observed that these large engines are working for 18s. 6d. per week each engine, or 1¼d. per unit."

—The New York Independent, the leading weekly newspaper of the world, and one whose pages exercise the widest influence, is entering upon its fiftieth year of publication The Independent emphasizes its fiftieth year by changing its form to that of a magazine, and by reducing its annual subscription price from $3 to $2; single copies from 10 to 5 cents. The Independent, in its new form, will print 3,640 pages of reading matter per year, at a cost to subscribers of $2, while the prominent magazines, which sell for $4 a year, print only about 2,000 pages. The subscriber to The Independent gets 82 per cent. more of equally good reading matter at one-

half the cost! It is not only the leading family weekly newspaper, but by far the cheapest and best. A free specimen copy may be had by addressing, The Independent, 130 Fulton Street, New York.

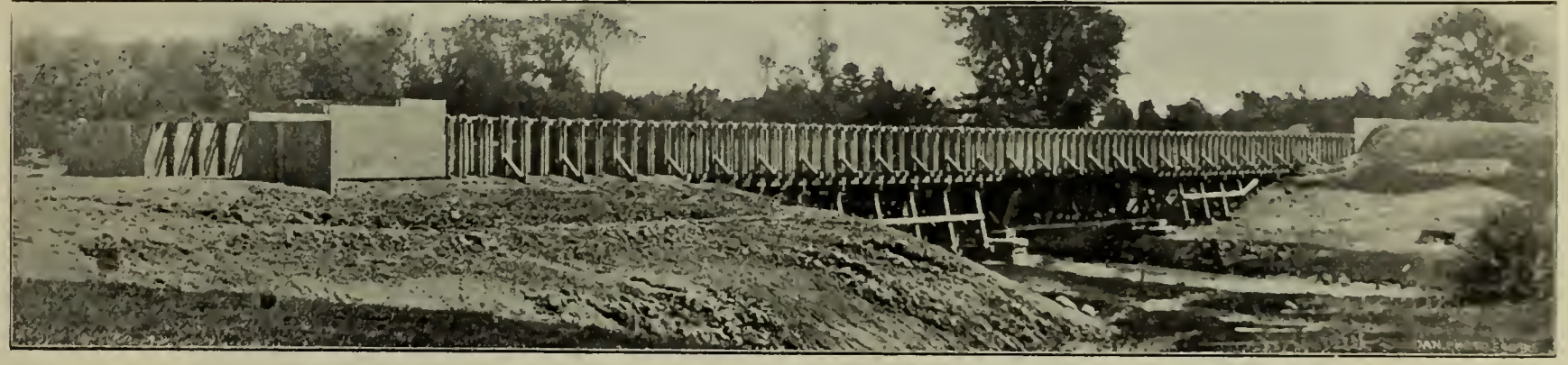
THE CATARACT POWER CO., OF HAMILTON, ONT., LTD.

Saturday, November 12th, will go down in the electrical annals of Canada as a red letter day, as it will chronicle the formal opening of the electric power plant of the Cataract Power Company, Hamilton, Ltd., for the transmission of electrical energy from a point on the Niagara escarpment, near DeCew Falls, to Hamilton, a distance of 35 miles, the conception and carrying out of which must always stand as a monument of the business pluck and enterprise to those interested in and forming the Cataract Power Company.

Over three years ago, when the transmission of energy by electricity over long distances for commercial purposes was still in much of an experimental stage, the possibility of utilizing the magnificent fall of over 200 feet, obtainable at DeCew Falls, where the waters of the Beaver Dams creek tumble over the Niagara escarpment, for the generation of electrical energy to be transmitted to the city of Hamilton, 35 miles distant, suggested itself to John Patterson of that city. After numerous surveys and examining into the physical feasibility of the scheme, he associated with himself the Hon. J. M. Gibson, John Moodie, sr., James Dixon and J. W. Sutherland, all well-known citizens of Hamilton. Together they procured a charter and formed the Cataract Power Company of Hamilton, Ltd., for the purpose of the development of this power and the transmission of it to Hamilton. After the formation of the company, the ground was again gone over carefully, and it was found advisable to abandon the original idea of utilizing the waters and water-ways of the Beaver Dams Creek and the DeCew Falls, and by changing the plans, some very material advantages were gained: The securing of a supply of water, which would be constant, through a feeder from the Lake Erie level of the Welland Canal at Allanburg; the construction of a canal, 4¾ miles long, over private right of way, thus giving the company an unobstructed water-way; the securing of land along the private water-way for storage basins, by which the company can conserve its water at a period of non-use or light load for use at the time of heavy load; and by going three-quarters of a mile east of DeCew Falls along the Niagara escarpment an additional fall of 75 feet was obtained, which was a very valuable acquisition. At this point there were also exceptional natural advantages, both at the top of the escarpment for the anchorage of flumes, erection of penstocks, etc., and at the foot of it, for the discharge of the tail water, as well as a splendid site for the power house.

The hydraulic development, as it was desired by the Cataract Power Company, presented obstacles which, owing to the large units and to the high head, made it exceptionally difficult to secure a builder of waterwheels who would give what the hydraulic engineer's specifications called for. After a long delay and much negotiation the Stillwell-Bierce and Smith-Vaile Company of Dayton, Ohio, agreed to build special horizontal turbines of a capacity of about 2,000 horse-power each, to work under a head of 275 feet, and to operate at a speed of 400 revolutions per minute. This required, also, special valves and valve gear, and controlling devices, all of which were specially designed for this particular plant. The generation of the electric power and the transmission of the same from the power house to the city of Hamilton, a distance of 35 miles, presented at that time a seemingly insurmountable obstacle to the carrying out of the scheme, no transmissions of energy, such a long distance, for commercial purposes, having up to that time been undertaken. The largest electrical concerns, both in Europe and America, were consulted, but the limitation of a practical working pressure, sufficiently great to insure the transmission of power such a long distance, practically precluded the undertaking of the work by any of the companies consulted, the highest working pressure, up to that time, being not above 10,000 volts. At this working pressure the cost of the transmission line became so great that the Cataract Power Company did not feel warranted to undertake the development of the enterprise. The longer the distance, the heavier the conductor must be; therefore, to transmit over this long distance, it was necessary that the pressure be 20,000 volts or over, so that the cost of the conductor would be within the limit set, of allowing the Cataract Power Company to undertake the development of the enterprise. After nearly a year of futile attempts to have the work undertaken at a pressure which would justify them in proceeding with the work, and being unsuccessful, they consulted J. A. Kammerer, one of the staff of the Royal Electric Company of Montreal, and after careful consideration of the conditions and preliminary estimates of the work being made by him, and a working pressure of 24,000 volts guaranteed, the Royal Electric Company agreed to undertake the work which, with its consequent saving, brought the cost within the limits deemed necessary by the Cataract Power Company to admit of their proceeding with the work.

The first ground was broken on October 5th, 1897, and the work was pushed with such vigor that the current was sent over the lines, from DeCew Falls to Hamilton, on the afternoon of August 25th, 1898, or just 10 months and 20 days from the beginning of work.



THE CATARACT POWER CO.—AQUEDUCT OVER BEAVER DAM CANAL

THE CANAL.

The water for this plant is secured through a feeder from the Lake Erie level of the Welland canal at Allanburg. The arrangement of the gates as shown in the illustration, is such as to admit of the unwatering of the lower levels of both the old and new Welland canals without interfering with the company's supply of water. From Allanburg the company has a private canal extending north-westerly to the edge of the Niagara escarpment, a total distance of about four and one-half miles. At three different points there are placed gates for regulating or shutting off the supply so that the water is under complete control. Where the canal crosses the Beaver Dams creek, the water is carried in a closed wooden flume supported on a steel truss. This flume is placed below the level of the water in the canal at each end so that the contained water is always under pressure, which is intended to prevent leakage. The water follows generally the water courses of a succession of small streams, consequently there are few heavy cuts or fills. In a number of places the contour of the ground formed a natural bed for the canal and no work was necessary. At the heavy cuttings, the banks to the bottom of the canal are pitched with stone and the important embankments are rip-rapped to prevent erosion.

At the lower end of the canal, near the mountain top, are located three large storage reservoirs, having a total area of thirty-three acres. These are sufficient to contain forty-eight

hours' supply of water and will meet the hourly inequalities of demand usual in electric supply companies, as well as allowing the unwatering of the upper stretches of the canal for repair purposes, without the interruption of the service. Throughout the whole length, the work is of particularly substantial character, the factor of safety being exceptionally large, and all the requirements of the service seem to have been carefully considered. The large reservoirs being located immediately at the mountain's edge, where the water enters a steel pipe, and the long stretches of slow current canal, it is expected will promptly freeze over and prevent any trouble from frazil or anchor ice. In this matter the water power is particularly fortunate, as there is practically dead water to Lake Erie. The canal is designed to carry sufficient water to develop from 10,000 to 12,000 horse-power without creating an erosive speed in the current. The waterways and appurtenances were constructed under the supervision of Thos. E. Hillman, C.E., resident engineer, and under the general approval of Wm. Kennedy, jr., Montreal, engineer-in-chief.

THE PIPE.

At the brow of the mountain, the water is delivered through a concrete fore bay, protected by suitable racks and head gates, to a large steel pipe which carries it directly down the mountain slope to the power house, 260 feet below. The pipe is of steel plate, double riveted on both longitudinal and transverse seams. It is 745 feet in length and varies in diameter from 8 feet 6 inches at the top to 7 feet 6 inches at the bottom. The steel used for the top section is ¼-inch in thickness and gradually increases in size down the slope until at the bottom it is 13-16 of an inch.

THE CATARACT POWER CO.—POWER HOUSE AND PIPE LINE.

The weight of this pipe is all supported from the top, where a number of heavy flanges are built into several piers of concrete placed in the rock cutting. Down the slope, at intervals of fifteen feet, supporting masonry foundations are constructed. A substantial double housing of matched lumber is now being built over the entire length to protect the pipe from extreme changes of temperature. About two-thirds of the way down the slope is placed an expansion joint to take care of any elongation or contraction. In addition to serving this purpose, the joint is so designed as to support the part of the pipe below it. This is accomplished by means of the water pressure acting against an annular piston attached to the lower section, the piston working in a cylinder attached to the upper section. From the top the pipe runs downward at an angle of about twenty degrees for about two-thirds of its length, where it reaches a level bench about sixty feet wide, and then continues downward at the same slope to the bottom, where it turns with a gentle curve, almost a right angle, and extends underneath the floor of the power house.

POWER HOUSE.

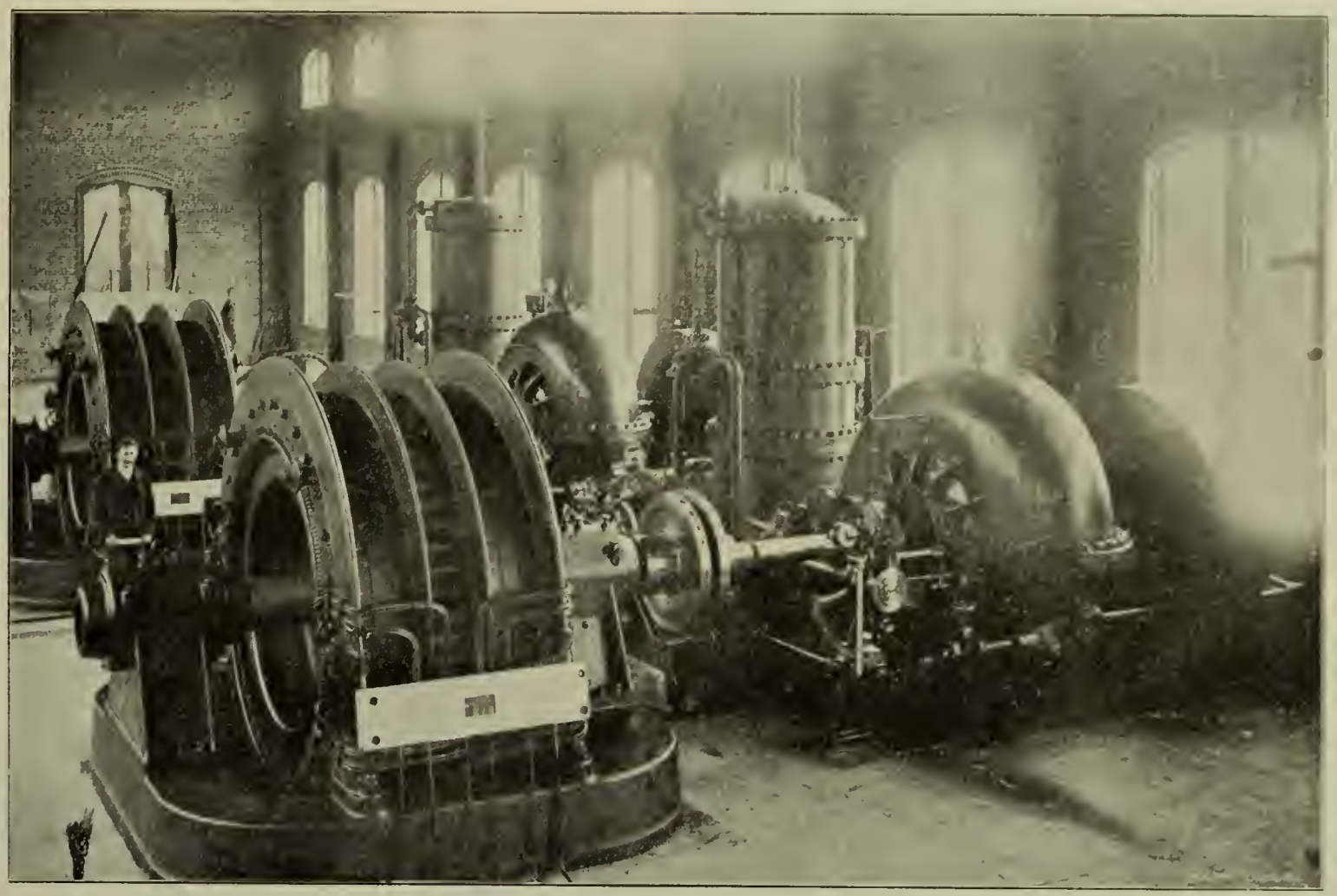
The power house building is a substantial structure of iron and brick, 174 feet by 42 feet, with a galvanized iron roof over matched board sheathing. It is designed to accommodate four complete generating units, and the necessary step-up transformers, switchboards, etc. Only two units and half the capacity in transformers are at present installed. The building is lighted by clusters of incandescent lights, and will be heated by electric heaters. The main supply pipe enters at the end of the building below the floor level, and inside the building widens out into a steel receiver, ten feet in diameter, which is solidly imbedded in concrete underneath the floor. From this receiver four branch pipes come up through the floor, with a quarter turn for delivering water to the branches. In these branch supply pipes are placed the large vertical hydraulic gates, shown in the illustration. These gates are 36 inches in diameter, and are operated by hydraulic pressure by means of a four-way valve, controlled by a lever. These valves will open or close in less than a minute. The gates, as well as all the hydraulic machinery, were supplied by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. Beyond each gate valve is placed a 12-inch spring relief valve, to relieve the pressure when it exceeds that due to the normal static head. The turbines are 1,950 h.p. each, and run at 400 revolutions under the normal head of 280 feet. The water wheels are of the inward flow central discharge reaction type with cylinder gates. We believe that this is the highest head employing this type of turbine, most of the high head plants using the jet or impulse, peripheral bucket design wheels. In order to withstand the unusual pressure, the runners, the gates and all parts susceptible to wear are made of bronze, and everything is made extremely heavy and has been specially designed for this plant. The water enters the wheel horizontally and discharges vertically downward through a draft tube 14 feet in height. Each unit is equipped with a Stillwell-Bierce & Smith-Vaile electric governor of the Giessler design for controlling the speed. On the outer end of the shaft is placed a 7½ ton steel fly-wheel with an outboard bearing. The combined influence of the enlarged receiver, the relief valves and the heavy fly-wheels are calculated to overcome any tendency to water hammer.

The entire electrical equipment was supplied by the Royal Electric Co., of Montreal. The generators are of their well known S.K.C. inductor type, generating two-phase current at 2,000 volts, running at 400 revolutions per minute. Each of the two generators at present installed is of 1,000 k.w. rated capacity. They are connected direct to the turbine shaft by means of an insulated flexible coupling composed of two flanges with projecting pins the alternate pins being joined by sole leather links. The generators rest on base frames of seasoned Georgia pine to insulate them from the foundations. The stationary armature coils are wound of bare copper strip separated by sheet mica insulation. The inductors of these machines weigh over twelve tons, which weight running at such a high speed requires most careful workmanship. The entire absence of vibration and general smoothness of operation is certainly creditable to the manufacturers. The wires connecting the generators to the switchboard are laid in conduits in the floor, which are covered with iron girdles so that they are accessible at any point. There are two exciters of 30 k.w. capacity, each driven by a separate turbine. Each exciter is

calculated for supplying the full equipment of four generators. They are likewise directly connected to and insulated from the turbines.

The main switchboard, as is shown in the engraving, is made up of three white marble panels, one for each generator and one for the exciters. On the generator panels all the connections are made on the back of the board, there being no terminals on the face. The switches are of the S.K.C. slide quick break type, and are provided with automatic shutters to prevent arcing. They are double throw, connecting to two separate sets of bus bars, so that the machines may be run on separate lines or in parallel, according to the future requirements of the service. Each generator panel contains a volt meter with a double throw switch connected to both phases, an ampere meter on each phase, and a direct current ampere meter in the filed circuit of the generator. The cases of the instruments are made of ground glass, and present a very attractive appearance. The exciter panel contains the usual instruments for operating two shunt-wound direct current machines in parallel and also contains the synchronizer, which is of the ordinary three lamp type. A special feature is the absence of generator fuses. As the S.K.C. generators supplied were made especially by the Royal Electric Co. to withstand a heavy overload, it was considered safer to risk the strain upon the generators due to a short circuit rather than by the blowing of generator fuses, to cause the instant removal of the entire load from the water wheels.

Immediately back of the switchboard and taking up one end of the building are located ten of a new type of S.K.C. transformers used to raise the potential delivered by the generators to 22,500 volts on the transmission line, at which pressure it is now operated. These transformers are arranged in batteries of five, each transformer having a capacity of 200 k.w. They are artificially cooled by means of water pipes supplied direct from the penstock, the pressure being reduced by means of throttle valves. The transformers are encased in tanks made of steel boiler plate, and rest directly on the concrete floor. The coils are wound in sections carefully insulated, and separated by unusually large air spaces, and the whole immersed in mineral seal oil. This construction has been found to admirably answer the purpose of this exceedingly high voltage, each transformer being tested with a break down strain of 40,000 volts before being installed. A novel feature of the installation, is the switchboards which accompany each transformer. They are of specially selected white marble, and contain two single pole high voltage switches, and one double pole 2,000 volt switch, the two high voltage switches being separated by a marble barrier. The high voltage switches consist of a flexible cable, having a screw plug attached to one end and a socket to the other, the socket being attached to a hardwood pole, four feet in length, for safe handling. The socket and the plug which it fits over are tipped with non-arcing metal. By means of these specially constructed switches the 22,500 volt circuit can readily be opened. The low voltage switches are of the S.K.C. slide quick break type on the back of the switchboard. Each transformer is also equipped on both the primary and secondary sides with enclosed non-arcing fuses



THE CATARACT POWER CO.—GENERATING UNITS IN THE POWER HOUSE.

The 22,500 volt wires inside the building are all covered with a specially heavy insulation of rubber, and are supported on porcelain line insulators on an overhead rack, all being in plain sight and easily accessible. From the transformers, which are connected five in parallel on each phase, the circuit runs to the line terminal board, consisting of four high voltage switches similar to those placed on the transformer, except that they have double terminals, in order that they may be changed to either of the two lines contemplated by the company. Immediately above the line terminal board is placed a specially constructed lightning arrester equipment composed of 60 S.K.C. non-arcing arresters with their special appurtenances and connections. From the lightning arresters the wires pass upward and out through the wall of the building at a height about 30 feet from the floor.

THE LINE.

The high voltage wires are carried through the brick wall forming the gable end of the power house, by means of lead encased rubber covered cable, protected by vitrified pipe, the cable being kept clear of the pipe by wooden bushings specially prepared in oil. After passing over a crossarm attached to the building, the lead covered cable is joined to the bare copper transmission wires, by means of a long, carefully made waterproof joint. This special construction has proved entirely satisfactory. From the power house the transmission line crosses the Twelve Mile creek, and runs up the hill opposite, on private property, to a concession road, thence along this roadway due north to the Grand Trunk railway, and then westward along the railroad right of way on an almost perfectly straight line to the company's step-down station at Hamilton, a total distance of a little less than 34 miles. The transmission wires are four in number and are No. 1 B. & S. medium drawn bare copper. They are all placed on one four pin crossarm 3¾ feet by 5¾ feet, spaced 18 feet apart, and are supported on porcelain insulators of the Redlands type, supplied by the Imperial Porcelain

Company. The pins are of special design, holding the insulator two inches higher from the crossarm than the standard practice. This is to avoid trouble from heavy snow or sleet.

THE CATARACT POWER CO.—WATER WHEEL LINE.

The pins are of yellow locust, specially prepared in oil, and are fastened into the crossarm with a wooden pin instead of being nailed, so as to use as little iron as possible. The poles are all specially selected with 8 inch tops and not less than 35 feet in length. They are set 90 feet apart and 6 feet deep in the earth. The height of the poles varies with the contour of the ground, so as to keep the wires as nearly horizontal as possible. In marshy places a crib filled with stone is built around the base of the pole, and where the line crosses the Jordan river, the poles are placed in a cluster of piles specially driven for the purpose. On the top of the poles is run a galvanized iron barb wire grounded at every pole by means of an iron plate for lightning protection. Below the transmission crossarm is placed a two-pin crossarm carrying the telephone circuit. The telephone circuit is a complete metallic circuit of No. 10 B.W.G. galvanized wire, transposed at every fifth pole. This arrangement has been found to give satisfactory service with the heaviest currents yet passed over the line. The insulators were all carefully tested with a breakdown pressure of 60,000 volts, both at the factory and again at Hamilton before being put up, with the satisfactory result that not one has broken down, or produced the slightest trouble in the three months during which the line has been in operation, notwithstanding the unusual rain and sleet storms during that period The construction of the pole line was done by Lowe & Farrell, of Hamilton, the Cataract Power Company supplying the material. This work has been executed in a very creditable manner

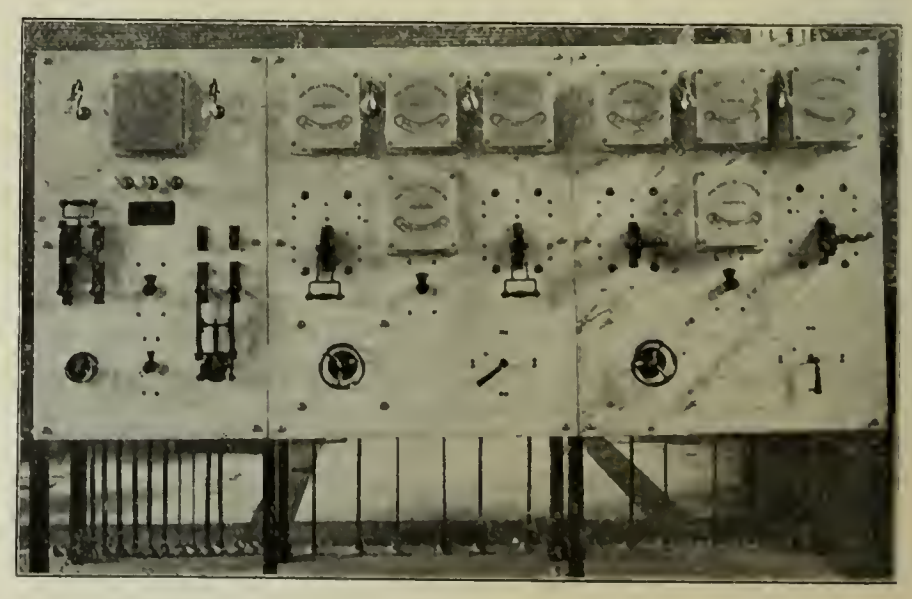
TRANSFORMER SUB-STATION AT HAMILTON.

The company's step-down station is located at Victoria avenue, immediately beside the Grand Trunk railway's right of way, about one mile within the city limits. It is a neat structure built of brick with a slate roof and specially designed for this purpose. At this point the voltage is reduced to 2,000 volts, at which pressure the current is distributed through the city in four separate circuits. The line wires are carried through the brick walls of the building in the same manner as at the power house. There is the same arrangement of lightning arresters, high voltage lines and two batteries of transformers. The transformers, however, are arranged so as to be artificially cooled at times of heavy load by means of an air blast. The transformers rest over an air duct in the floor, and are provided with a ring of vertical air ducts, passing up through the oil. The blast arrangement, which consists of a No. 6 Sturtevant Blower, direct connected to an S.K.C. two-phase induction motor, delivers air directly into this duct, which then passes upward through the transformers. In the transformer room is also placed the distribution switchboard, and, as at the power house, only half the ultimate capacity of the transformers has been installed, the building being designed to accommodate two more batteries of five, similar to those already placed, consisting of four panels each, containing two ampere meters, two double pole double throw switches, and four duplex fuse blocks. From this distribution switchboard incandescent lighting current is supplied for the Hamilton Electric Light & Power Company, as well as for motors on premises of customers throughout the city. From the switchboard the circuit wires pass upward to a cupola in the roof at which point they are joined to the distribution circuits. The line supplying the incandescent service is a four wire two-phase circuit, but the circuits devoted exclusively for power, are composed of three wires only.

At the premises of the Hamilton Electric Light & Power Co. is being installed a new circuit switchboard arranged to accommodate the old single phase lighting circuits of this company. Each circuit is equipped with a double throw switch in order that the load may be divided with a regulating transformer in order that the pressure may be controlled from this point. The old house to house 1,000 volt 16,000 alternation transformers have all been replaced by new S.K.C. 2,000 volt 8,000 alternation transformers in larger units, and the service all changed to this higher pressure in order to reduce the losses and obtain better regulation. In addition to supplying the Hamilton Electric Light & Power Co.'s service, the Cataract Power Company has already contracted for a large amount of power for operating factories of different kinds in the city. They expect within a short time to supply the various electric railways in and about Hamilton, and to replace nearly all the steam engines in the various manufacturing establishments with electric motors.

CATARACT POWER CO.—IN-TAKE AT ALLANBURG.

The plant has been in practical operation for several months, and has thoroughly demonstrated the success of electrical transmission at this high voltage and long distance, which speaks well for the carefulness in designing and construction of the work. The officers of the company are: Hon. J. M. Gibson, president; John Moodie, treasurer; John Patterson, secretary; H. R. Leyden, general manager, the latter having had general charge of all the construction operations.



THE CATARACT POWER CO—GENERATOR SWITCH BOARD.

INAUGURATION.

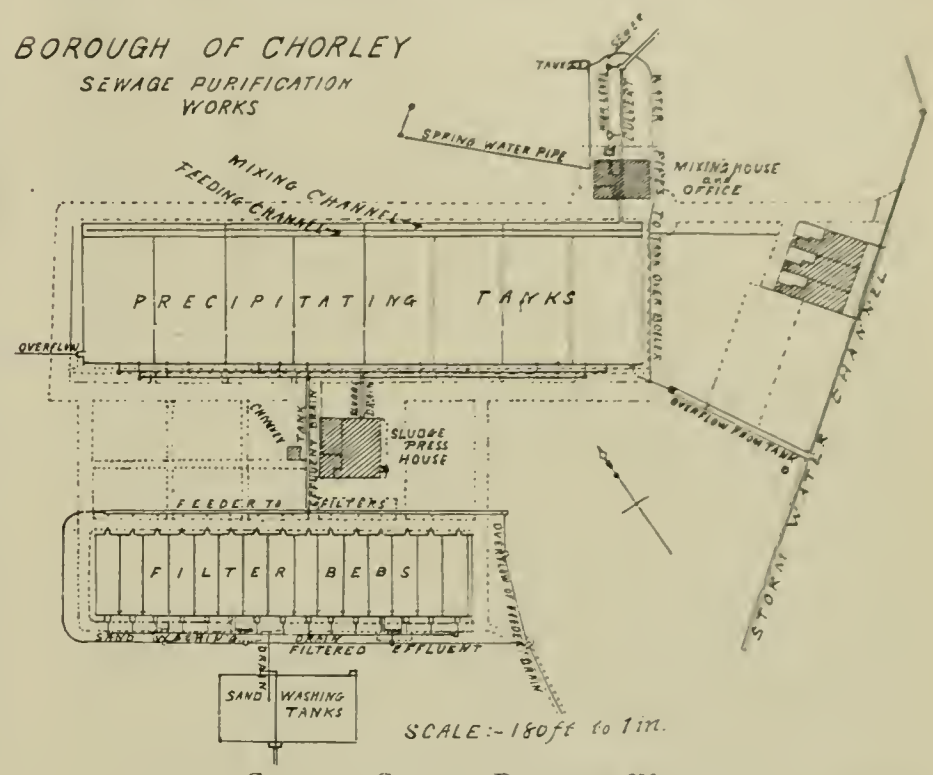
The formal inauguration of the Cataract Power Co., of Hamilton, Ltd., plant at DeCew Falls and Hamilton, Ont., took place on Nov. 12th, when a large company from Toronto, Hamilton and the surrounding towns and cities enjoyed the splendid hospitality of the company. The party left the Grand Trunk station, Hamilton, at 12.30 and went to St. Catharines, from which carriages were provided to DeCew Falls. Among those present were: Hon. J. M. Gibson, president of the Cataract Power Company, Mayor Colquhoun, Ald. Carscallen, M.P.P., A. T. Wood. M.P., T. H. MacPherson, M.P., Adam Brown, J. Turnbull, City Solicitor Mackelcan, John Patterson, John Moodie, Reginald Kennedy, H F. Gardiner, Ald. Metherell, Dr. Osborne, George Tuckett, H. H. Witton, E. B. Wingate, Chester Fearman, Robt. Thomson, A. F. Pirie, of Hamilton; J. J. Wright, E. H. Keating, City Engineer Rust, Assistant City Engineer Fellowes, A. E. Osler, W. H. Maclean, M.P., and others, Toronto.

When the power-house was reached the machinery was found running at full speed, and the whole plant going in marvelously fine shape. The visitors spent an hour in inspecting it. After that a splendid luncheon was partaken of. The chairman, Col. Gibson, proposed the health of the Queen and Parliament. Congratulatory speeches were made by A. T. Wood, T. H. Macpherson, William Gibson (Lincoln), W. F. Maclean and A. F. Pirie. John Moodie and John Patterson also spoke. The train was then taken for Hamilton, where the transforming station was visited. The day was a success from every standpoint both as a successful inauguration of a magnificent plant and as a most enjoyable social event.

THE CHORLEY, ENGLAND, SEWAGE WORKS.

The following is an abstract from the description of the method of sewage purification in use at Chorley, Eng., which was submitted to the Toronto city council by Ald Hallam on his return recently from England: The inlet channel of the sewage from the town leads to a catch basin or pit, the object of which is to catch the detritus, such as road scrapings, sand or gravel and heavy material generally, which will not float, and thus to prevent objectionable materials going into the precipitation tanks, where it would have to be taken out and pressed at much cost. Formerly in case of storm the sand, etc., from the roads washed into the tanks in cart loads. These catch pits are cleaned out about once a week. Some of the storm water comes down here, but most of it goes through the storm water channel, in fact the River Committee of the county council permits, when the flow is three times the normal quantity, to send it direct to the river. This, however, does not often occur, and when it does it is only for a limited period.

The sewage after passing over the catch pit passes through a screen to which is attached a rake or scraper. This scraper is driven by a water wheel, which is worked by a flow of sewage brought to a higher level. The object of the scraper is to keep the bars of the screen free from refuse which has not precipitated when passing over the catch pit, for example, corks, wood, paper, and other floating bodies. From here the sewage flows into the main distributing channel, but before it got there the precipitant (ferrozone), is added in proportion of from 10 to 14 grains per gallon, according to the foulness of the sewage. The quantity of the precipitant is left to the discretion of the man in charge of this part of the works, as it cannot be done automatically. He continually tests the sewage throughout the day, because it varies almost from hour to hour. Comparatively little ferrozone is required during the night time. In addition to the main flow over the catch pit we have a higher level flow, which is brought up under pressure in order to work the water wheel, which is used for two purposes: 1st. For turning the screening arrangement as before stated, and thus saving expense in the generation of steam, and 2nd. For pumping water from a well of spring water, into two large iron cisterns, which are used to supply drinking water to the cottages of the workmen, and also to provide water for the steam engine boiler attached to the steam engine in the press house. If there were a larger flow of sewage and the gradients were right, it would be quite possible to get all the power required from the large water wheel driven by the sewage itself. But the fall in the land sewer is not sufficient. In the mixing room there is an arrangement for mixing the ferrozone with the sewage. The sewage water is diverted from the pipe which turns the water wheel and proceeds underneath the bottom of the tanks, and as it enters these receptacles it takes up particles of ferrozone, making a solution of ferrozone and sewage water, which is mixed by a vertical agitator in each of the tanks, from this the mixed sewage floats into the main distributing channel, which runs the whole length and back again of the eight precipitation tanks. These tanks have a capacity of 140,000 gallons each, the dimen-



CHORLEY SEWAGE DISPOSAL WORKS.

sions will be seen from the plan. Each tank contains from six to seven feet of sewage water. The distribution channel is furnished with both side and baffle plates to assist in the thorough mixing of the ferrozone with the sewage water. In Chorley they are just undergoing a change from the pail to the water carriage system. In the collection of the pails there is spent £1,400 a year, and the contents of the pails are poured into the sewer "en masse." As these pails are only collected weekly, secondary decomposition is set up, and the treatment of the sewage rendered more difficult than would be the case if water carriage were the rule instead of the exception.

It is for this reason that the amount of ferrozone varies from 10 to 14 grains per gallon, if the condition of the sewage was normal, the probability is that 10 grains of ferrozone per gallon would be ample. The mixing channel runs the whole length of the tanks and parallel to them, and leads to the channel which feeds each of the eight tanks. The mixed sewage is allowed to remain in the tanks until such time as in the judgment of the man in charge it is in such a state of precipitation as to be allowed to go into the filters. The time of precipitation varies from two to five hours.

Each of the precipitation tanks is provided with two valves; one for liberating the semi-pure sewage water and the other for liberating the sludge. When as much water as can be drawn from the tanks has been taken, the sludge valve is opened; the man then goes into the tank and removes the sludge at the bottom of the tank towards the valve. There is a fall in the bottom of the tank, and also a fall in the sludge channel to the wall underneath the press house. From this well the sludge is forced up into the press by means of compressed air at a pressure of from 75 to 95 pounds per square inch, water to the extent of 90 per cent. of the sludge is extracted by pressing, leaving a sludge cake 35 to 40 per cent water. The valve which liberates the water which then goes to the filters is provided with a floating arm, the use of which is to prevent the floating scum from going into the filters. The purpose of this is to get the water into the filters as pure as possible. When the water leaves the precipitation tanks it is brought down a central channel, and then diverges to the right and left in a distributing channel, which runs parallel to the fifteen filters, which constitute the system.

Each of these filters has a superficial area of 100 square yards. The system in vogue at Chorley is on the intermittent principle, that is, from two to three inches of sewage water only is allowed on the surface of the filter, these two or three inches are allowed to gravitate through the filter, a process

which takes from 30 to 40 minutes, and at the expiration of that time a further flow is put in the filter. The object of the intermittent flow is to provide that the sewage water as it passes through the strata of the filter shall draw air after it. By so doing, the interior of the filter may be said to be purified every time it is used. Each filter has a channel down the centre (on the surface), a perforated wooden trough patented by the chairman of the sewage works committee. The trough is 6x6 inches, and it has three rows of perforations; the object being to equally distribute the water over the surface of the filter without disturbing the top strata (sand), it also helps to oxygenize the sewage water. By this means the water can be placed in the filter at least three times as quickly as when the ordinary iron trough is used. In the latter case the water as it flows from the trough continually stirs up the sand with the effect of mixing the clean and dirty sand together, thereby making the washing of the filters much more expensive. It is contemplated to flush the filters automatically by means of a syphon attachment. The water having passed through the filters, which are arranged in triplets, goes into the river, along an outfall channel, having the appearance, smell and taste of spring water; in fact so pure is effluent, states the report, that a tank has been constructed in which gold fish have now lived for over six months.

The next process is washing the filters. The whole of the filters are washed every week, three per day, the remaining time of washing is used in cleaning the various channels, in fact, one of the great secrets of the success of the works after the construction, must be attributed to the cleanliness of everything about the place. For precipitation works to do their work properly it is absolutely necessary that all channels, except sludge channels, be continually washed out, the filters are washed by means of an upward flow as follows: Two of the filters are filled with effluent from the precipitation tanks, the water filters through each of these and ascends as filtered water into the third, which has to be washed. When the water makes its appearance in the third filter, the washing men, who are provided with waterproof boots, go into it with rakes and brushes and thoroughly agitate and disturb the surface of the sand, which the percolation of the water from the other two filters into the third readily allows them to do, the object of this is to take out an amount of suspended matter which has been left in the filter by the sewage effluent in its progress through the filters. This impurity generally penetrates three inches from the top of the bed, and the work of the filter washers is not complete until the whole of the impurity is comparatively speaking, removed. Whilst this work is going on, the penstock at the bottom of the filter to be washed is opened, in order that the polluted water, the product of the water which has come out of the other filters, and the suspended matter in the sand at the top of the filter under course of washing, may flow through this sand washing water, then proceed down a central channel provided with catch pits to intercept any sand which may be escaping, in order that it may be washed and put back again into the filters into two tanks, whence again it flows by gravitation to a well near to the press house, where it is pumped into the precipitation tank for retreatment; the four inch pipe which conveys the sand washing water goes underneath the filters. The pump has a capacity of 20,000 gallons per hour.

Where lime is used as a precipitant there is a tendency to secondary decomposition. The cost of the precipitant ferrozone is 40s. per ton. Without the intermittent flow it would be absolutely impossible to get the purity of the effluent that is secured at Chorley, the report states; the watershed committee insists upon a certain standard of purity, and it is secured by means of the intermittent system of purification. The cost of the Chorley works is about £18,000. The filters have each 3 feet 1 inch of material. The top strata is composed of fine sand from Fleetwood Harbor. The second of sand and polarite mixed in the proportion of 6 inches polarite and 5 inches sand. The next layer is composed of finest gravel and then follow in rotation pea, bean and walnut gravel, and at the bottom, small boulders.

Population of Chorley, 26,000. The quantity of sewage treated daily varies from 750,000 to 1,000,000 gallons. The crude sewage contains from 3 to 5 per cent. of albuminal ammonia. The purified effluent contains .036 to .075 per 100,000 parts.

MECHANICAL DRAFT FOR STEAM BOILERS.*

BY WALTER B. SNOW.

The first requisites for the successful combustion of fuel are the supply and proper distribution of a sufficient amount of air. To insure the fulfillment of these requirements in steam boiler practice, draft is necessary and the force of the draft must be expended in two ways. First, a portion is necessary to overcome the resistance of the grate and the fuel upon it, of the combustion chamber, flues or tubes and uptake, and of the means of connection to the source of draft, be it fan or chimney. The sum of these resistances is a measure of the pressure head. Second, the draft must, in addition, be sufficient to impart to the air the necessary velocity to furnish the amount requisite for the direct purposes of combustion. This is a measure of the velocity head. With a constant total head any change in the resistances immediately alters the relation between the pressure and velocity heads. Professor Gale found, in the case of a stationary boiler furnace of ordinary construction, that only about 4 per cent. of the total draft pressure was actually expended for the production of velocity, and the movement of the air. Therefore, designs for draft-producing apparatus must first contemplate the creation of sufficient intensity of draft to overcome all resistances, and then provide capacity for the necessary amount of air.

In the case of a chimney, the maximum draft, being dependent upon its height, is constant for the same temperature, and regulation of the combustion can only be secured by throttling the air supply. With a fan, however, the intensity of the draft may be instantly changed from zero to the maximum with a proportional increase in the air volume. Properly, the draft to be determined in practice is that relating solely to the supply of air to, and the overcoming of resistances in, the fire. This is obviously the difference between the over and under-grate pressures. Approximately, the volume of air supplied (for equal temperatures) is an index of its velocity and varies directly as the square root of the effective pressure or draft. Conversely, the required draft will vary as the square of the rate. The chimney has long stood as practically the only available means of producing draft, which, thus produced, has commonly been called "natural draft." Primarily introduced for the purpose of increasing the rate of combustion, artificial draft was designated as "forced draft." Artificial draft may be produced by means of steam jets inducing a flow of air, by blowing engines, by air compressors, by positive rotary blowers and by fan blowers or exhausters. The fan has, however, become the accepted symbol of artificial, or mechanical draft, and is to-day the accepted substitute for the chimney.

Two types of fans exist. The first, known as the disc or propeller wheel, is constructed on the order of the screw propeller and moves the air in lines parallel to its axis. It is practically valueless for draft production. The second, or fan blower proper, consists in its simplest form of a number of blades extending radially from the axis, and presenting practically flat surfaces to the air as they revolve. By the action of the wheel the air is drawn in axially at the centre and delivered from the tips of the blades in a tangential direction. This type may be simply designated as the centrifugal, or peripheral discharge fan. The degree of vacuum which may be produced at the inlet, or of pressure which may be maintained at the outlet, of a fan of this type, is dependent upon the circumferential speed of the wheel; and the velocity of the air discharged through an outlet of proper size is substantially equal to that speed. If the fan be allowed to discharge the air through a short and properly shaped outlet, the pressure created will, with an efficient fan, be substantially that required to produce the velocity. The relation between the velocity and the pressure or head is expressed by the well-known formula for falling bodies, namely—

$$V = \sqrt{2gh}$$

in which the head "h" is equal to the pressure divided by the density of the air. From this basis formula it is evident that the pressure created by a given fan varies as the square of its speed. The volume of air delivered is, however, practically proportional to the speed. The work done by a fan is

*Abstract of a lecture delivered before Sibley College, Cornell University.

represented by the distance through which the total pressure is exerted in a given time. It varies as the cube of the velocity; that is, as the cube of the revolutions of the fan.

The ordinary barometric and hygrometric changes in the atmosphere have no appreciable effect upon the pressure and power. But the density varies inversely as the absolute temperature, and, therefore, should enter as a factor even in calculations with reference to air at or about ordinary atmospheric temperatures, and must be taken into account when heated air or gases are handled. In the design of a fan wheel to meet given requirements it is necessary to make its peripheral speed such as to create the desired pressure, and then to so proportion its width as to provide for the required air volume. If possible a fan should never be made so small that it is necessary to run it above the required pressure in order to deliver the necessary volume. To double the volume under such circumstances requires eight times the power; three times the volume demands twenty-seven times the power.

The chimney as a means of creating a movement of air depends upon the heating of that air, by which a difference in density is produced. The heat thus employed is, however, absolutely wasted, so far as its utilization for any other purpose is concerned. This inherent loss with an ordinary coal actually amounts to about 20 per cent. when the gases are at 500°, and the excess of air is 100 per cent. Heat being the agency by which the air movement is brought about, the efficiency of a chimney must be measured by the amount of heat expended for this purpose. As heat is transformable into work, the efficiency is therefore to be measured by the number of foot-pounds of work represented by the pressure difference exerted through the distance moved, as compared with the number of foot-pounds represented by the total amount of heat expended.

It may be shown that when no work is lost in friction and the respective temperatures of the external air and the chimney gases are 62° and 500°, the theoretical efficiency of a chimney 100 feet will be only about six ten-thousandths.

If in the place of the chimney there be substituted an engine-driven fan of proper size, the resultant of the efficiencies of the steam boiler, the engine and the fan, together with the loss by friction in the apparatus, may be reasonably taken at about 4 per cent. Therefore, the work done, or its equivalent in heat units expended to produce the given result will be about 70 times as great in the case of a chimney as in that of a fan. All other questions aside, the fan is, therefore, far more economical than the chimney. This economy means that when a fan is employed, the surplus heat can be utilized and the gases reduced to a minimum temperature before they escape.

The methods of application of mechanical draft may be broadly classified under two heads—the plenum and vacuum methods. Under the plenum or "forced" draft method the air may be supplied in either of two ways. First, by making the ashpit practically air tight, and forcing the air into it. Second, by making the fire room itself practically air tight and maintaining therein the required air pressure. Under the vacuum or "induced" method there is practically only one means of application—that by the introduction of an exhausting fan in the place of a chimney. A short and comparatively light stack usually serves to carry these gases sufficiently high to permit of their harmless escape to the atmosphere.

The application of mechanical draft presents a three-fold opportunity for increased economy in steam production; first, in the reduction of avoidable losses, second, in a decrease in the first cost and resultant fixed charges on the entire generating plant, and third, in a reduction of the operating expenses, chief among which is the cost of the fuel. In addition, mechanical draft possesses certain advantages which cannot be directly measured in dollars and cents; such are its peculiar adaptability to the requirements, its independence of climatic conditions, its flexibility and the like.

The losses which are more or less avoidable are: First—Those due to incomplete combustion, as usually evidenced in the presence of smoke and carbonic oxide in the flue gases and in unconsumed coal in the ashes, as well as to a small amount of hydrogen or marsh gas which may pass out with the gases. Second.—Loss from excess of air, due to the fact that to secure practically perfect combustion, air is usually supplied in excess of the theoretical quantity chemically required for combustion. This loss is two-fold, being dependent upon the quantity of unused oxygen and associated nitrogen and upon the moisture in the air. Third.—The loss resulting from too high temperature of the gases leaving the boiler. This loss, except in so far as it is influenced by the air supply and the rate of combustion, is dependent upon the design of the boiler and its appurtenances, and, therefore, is not chargeable to the character of the fuel. It is one of the most important factors in fuel efficiency. Fourth.—Loss of heat by removing ashes at too high a temperature. This, by care, may be reduced but not entirely avoided. Fifth.—Loss by radiation. This may be reduced by increasing the thickness of walls and covering all exposed portions of the boiler. But from a practical standpoint it can never be entirely avoided. The presence of smoke indicates an absolute loss. Although this seldom exceeds 1 per cent. in ordinary practice, even this amount may be almost entirely eliminated and the smoke nuisance may, in most cases, be practically avoided by such regulation of the air supply and the intensity of draft as is possible under the conditions of mechanical draft. The loss of efficiency which ensues from the escape of carbonic oxide unconverted into carbonic acid is due to the much smaller amount of heat given out upon the incomplete combustion of carbon into the former gas. When a fire is suddenly thickened and deadened by additional coal, and large volumes of gas are given off, there is a demand for an increased air supply for the purposes of combustion. At the same time there is a tendency to clog the passages through which the air has previously passed, and thereby to prevent complete combustion at the surface of the fire. At this time, for perfect conditions, more air under greater pressure should be admitted, as is possible under the positive action of mechanical draft. The relative amount of unconsumed coal in the ashes is dependent upon the completeness of combustion and upon the original size of the coal or its tendency to decrepitate as well as upon the size of the free spaces through the grates. It has been conclusively shown that fine fuels can only be successfully burned upon special grates with an intensity of draft such as can be most economically produced by mechanical means.

A most important advantage of mechanical draft is presented in the opportunity which it affords for the proper regulation of the air supply. A certain amount of air is usually necessary for the purposes of dilution, but an unnecessary excess is productive of one of the greatest losses incident to steam generation. Theoretically, the amount of air chemically required for the combustion of one pound of coal is about 12 pounds. Donkin and Kennedy have shown by gas analyses that, in the case of 10 different plants, the air supply ranged between 56 per cent. and 328 per cent. in excess of the chemical requirements. If the air be supplied in excess of that necessary for perfect combustion, there is a definite loss, disregarding that due to moisture in the air, which is two-fold in its character: First, the excess of air entering the furnace is heated by the burning fuel, thereby lowering the temperature of the mixture of gases and air below that which would prevail if the gases only were present. As a consequence, the rate of absorption of heat by the water is reduced, for it is dependent upon the difference in temperature between the water and the gases. Second, owing to larger volume and higher velocity, there is less time to part with the heat and the temperature of the mixture of gases and air escaping to the chimney is higher than would be the case if there were no excess of air; while the increased volume is such that the total amount of heat thus carried away, without exerting any useful effect, is greatly increased. In other words, paradoxical as it may seem, the larger the volume of air supplied, the higher will be the temperature of the escaping gases.

A high furnace temperature and low stack temperature, other things equal, are evidently conducive to greater efficiency. It has just been shown that such conditions are incident to a reduction in the excess of air supplied. With a decreased supply of air, the intensity of the fire is increased, its temperature is higher, more heat is radiated to the exposed boiler surfaces, and more is taken up by the gases. Furthermore, the diminished superficial area of the grate and of the exposed interstices between the fuel necessitates a higher velocity to secure the admission of a given volume of air. This increased

velocity in turn requires greater draft or air pressure, which may be most readily produced by mechanical means. If a given grate be reduced one-half, and the rate of combustion be doubled, the same volume of air would have to travel through the exposed interstices at twice the velocity. But the pressure or vacuum required to produce this velocity would be four times as great, and, as a consequence, the air would be forced or drawn into spaces between the fuel which it could not reach under lesser impelling force. Much more intimate contact and distribution are the results. Less free oxygen passes through the fuel bed unconsumed, and for a given supply of air a higher efficiency of the fuel is attained. In experiments with a Wilkinson stoker, Witham has shown the most remarkable result of almost perfect evaporative efficiency with a combustion rate of 45.4 pounds and an actual deficiency of 11.2 per cent. in the air supply below the chemical requirements.

Undoubtedly the source of the greatest loss in boiler and fuel efficiency lies in the usual high temperature of the escaping gases. In seventeen independent boiler tests, Donkin and Kennedy found the heat lost up the stack, when no economizer was used, to range between 0.4 per cent. and 31.8 per cent. of the total heat of combustion. With the chimney a comparatively high temperature of the rejected gases is an absolute necessity to the production of the draft. Its production by means of a fan is, on the other hand, independent of the temperature of the gases, and there is, therefore, presented the opportunity to utilize the heat which is a positive and unavoidable loss in the case of a chimney. It is usually customary to abstract the surplus heat from the gases by some means in a sense independent of the boiler, such as a feed-water economizer, or a device for transferring the heat from the gases to the air supplied to the fuel, or both. Roney has shown in the case of nine boiler plants equipped with economizers and mechanical draft, an average fuel saving of nearly 14 per cent. of the total calorific value of the coal. With the Marland type of air heater, Hoadley reduced the total waste in the flue gases to only 5 per cent. of the calorific value of the fuel, and required only 1 per cent. of the total steam generated to operate the blower employed to produce the necessary draft.

(To be continued).

THE MANUFACTURE OF CARBORUNDUM AT NIAGARA FALLS, ONT.

The development of this new industry belongs to Niagara Falls, on both sides of the river. Not very long ago, the first kiln of carborundum ever made in Canada, and the second instance of its manufacture in the whole world, was opened in Niagara Falls, Ont. As yet the extent of its manufacture is not adequate to the number of uses that will create a demand for carborundum, and in a short time it is expected that the output will be very large in view of the rapid growth of its use in all work that requires an abrasive.

The first carborundum furnace consisted of an iron bowl lined with carbon, and a carbon rod: a mixture of clay and carbon was introduced into the bowl, and the rod placed in the mixture. A current sufficient to fuse the mixture, or at least to bring it to a very high temperature, was then passed through the furnace, the iron bowl and carbon rod serving as terminals or electrodes. When the current was cut off and the furnace had cooled down, it was opened, with the result that a few bright blue crystals were found surrounding the carbon rod. The furnaces constructed after this first experiment approached more nearly in form the furnaces in use to-day. They were built of brick, their internal dimensions being ten inches in length, four inches in width, and four inches in depth. The terminals were a pair of carbons, which could be moved longitudinally, thus permitting the distance between them to be altered at pleasure. These were essentially arc furnaces, that is to say, the idea was to form an arc between the terminals and to bring about the necessary chemical changes by the high temperature thus produced. Mr. Acheson, the patentee, soon found, however, that this method of working was not satisfactory, and he then set about constructing the incandescent furnace, which is the kind that is used to-day.

The crude materials for the manufacture of carborundum, viz.: sand, coke, sawdust, and salt, are received in the stock building. These are ready for immediate use. The coke must be reduced to kernels of a certain size to be used as "core," and ground to a fine powder to be used in making the mixture or charge for the furnaces. The furnace room is built to accommodate ten furnaces, though at present there are but five. The furnaces are built of brick, and have the form of an oblong box, the internal dimensions being approximately 12 feet in length, 3 feet in width, and 3 feet in depth. The ends are built up very solidly with a thickness of about 1½ feet. In the centre of either end are the terminals, consisting of 16 carbon rods, 20 inches long and three inches in diameter. The outer ends of the carbons are closed in a square iron frame. Finally, all the space between the inside of the plate and the ends of the carbons is tightly packed with graphite. Each plate is provided with a projection, to which the cables conveying the current may be bolted. These ends are the only permanent parts of the furnace.

The current, as supplied from the Niagara Falls Power Company, has a voltage of 2,200, and to use it in the furnaces it is transformed to a lower voltage.

After the circuit has been closed in the transformer room, no apparent change occurs in the furnace for about half an hour. Then a peculiar odor is perceived, due to escaping gases, and when a lighted match is held near the furnace walls, the gas ignites with a slight explosion. When the current has been on for three or four hours, the side walls and top of the furnace are completely enveloped by blue flame of carbon monoxide. During the run of a single furnace, five and one-half tons of this gas are given off. At the end of four or five hours the top of the furnace begins to subside gradually, fissures form along the surface, from which pour out the yellow vapors of sodium. At the end of about twenty-four hours, the current is cut off from the furnace and it is allowed to cool for a few hours. Then the side walls are taken down and the unchanged mixture raked off the top of the furnace, until the outer crust of amorphous carborundum is reached. This crust is cut through with large steel bars, and can then be easily removed from the inner crust of amorphous carborundum. The inner crust is next removed with a spade, and the crystalline carborundum exposed.

Carborundum is from two to five times dearer than emery, but meets with ready sale, as it is claimed by its makers to do more work and to do it faster and better.

Since Mr. Acheson discovered carborundum, in 1891, there has been other interesting work done on somewhat similar lines, notably that by Professor Henri Moissan, of France, though, as yet, none of it has resulted in the formation of a new industry, like the manufacture of carborundum. However, in the future, we may expect to see other wonderful results obtained from the electric furnace, in which temperatures can be reached that probably do not fall far short of that of the sun itself.

Among the characteristics of carborundum are: Hardness—Diamond is the only material exceeding it in hardness. It cuts emery and corundum with ease. Brittleness—Not as tough as the diamond, closely resembling corundum in this respect. Weight—Its specific gravity is 3.12. It is a little more than one and one-fifth times the weight of sand. One pound of carborundum is equal in volume to one and one-quarter pounds of emery. Infusibility—Infusible at the highest attainable heat. Decomposition occurs in the electric arc. Insolubility—It is insoluble in any of the ordinary solvents. Water, oils, and acids, have no effect upon it, not even hydrofluoric acid, which readily dissolves sand. Chemical Composition—It is composed of carbon and silicon in equal atomic proportions, and by weight, thirty parts carbon to seventy parts silicon. Its chemical formula is SiC. Color—Pure carborundum is white. In the commercial manufacture the crystals are produced in many colors and shades, partly as the result of impurities, and partly owing to surface oxidation. The prevailing colors are green, black and blue. The color has no effect upon its hardness.

The Carborundum Co. has made arrangements with the Hart-Emery Wheel Co., Ltd., Hamilton, Ont., to supply it with carborundum grains and powders, from which it will manufacture wheels, rub-stones, sharpening-stones, etc., and the Canadian trade will be fully supplied with these goods in the same qualities as are placed upon the United States market.

TORONTO CITY ENGINEER'S REPORT FOR 1897.

The annual report, published by the city engineer's department, of Toronto, has just been issued for 1897. The works of the year have been carried on under the direction of E. H. Keating, C.E., who was city engineer for nearly six years, and was succeeded by C. H. Rust, C.E., in February of the present year. From the report we learn that there were 0.46 miles of asphalt pavements laid in 1897, as against 0.366 miles in 1896, and 1.156 in 1895. In macadam, 0.510 miles were laid in 1897, 1.661 in 1896, and 1.663 in 1895. Gravel roads were laid in 1897 to the amount of 3.138 miles. None were laid in 1896 or 1895. Brick on concrete, 5.803 miles for 1897, as against 1.032 miles for 1896, and 0.744 miles for 1895. The unpaved roads in 1897 covered 78.45 miles. In 1896 they covered 79.74 miles. The total mileage for the year is 258.3, against 257.4 for 1896, 256.4 for 1895, and 253.4 for 1894. The different classes of pavements now laid in the city are as follows:

	Per Cent.
Cedar block	39.24
Stone and scoria	0.31
Asphalt	5.84
Brick	1.37
Wood and concrete	0.21
Macadam	15.68
Gravel	1.25
Cedar blocks with asphalt between tracks	2.10
Cedar blocks with brick between tracks	3.21
Macadam with stone setts between tracks	0.42
Unpaved	30.37

The waterworks consumed 10,355½ tons of coal, pumping 6,723,757,030 gallons of water. The Waterworks Department laid 503 services during the year. At the end of the year there were 2,982 hydrants in use. There were 1,556 meters of all kinds in use in the waterworks branch, of which 936 were Crown, 341 Worthington, and 231 Siemens & Adamson. There were 54 new meters put in during the year. In street sprinkling, the distance traversed by the three trolley tanks was 18,591 miles, the quantity of water discharged in the process of sprinkling amounted to 23,895,700 gallons, representing 8,893 loads. The quantity of water consumed in the ordinary watering service (wagons), was 37,045,375 gallons, or 75,296 loads, making a total for the season of 60,941,075 gallons, sprinkled on the streets.

THE CONSTRUCTION OF GARBAGE DESTRUCTORS.

BY FRANK LESLIE WATSON, ASSOC. M. INST. C.E.*

In the design and construction of a successful and economical refuse destructor plant, the following are the principal points which must be borne in mind:

A. It must never be forgotten that the primary object of a refuse destructor is, as its name implies, to destroy refuse, and to destroy that refuse as completely as possible, and without the production of any description of nuisance. By the term to destroy refuse in this connection is implied a practically absolute chemical separation of the combustible portions of the refuse (such as the carbon, phosphates and nitrates, which are found in cinders and in animal and vegetable matter), from the non-combustible portions (which are chiefly mineral), and includes the complete oxidation of the former class, and the fusion and agglomeration so far as is possible into hard clinker of the latter parts. It must be regretfully admitted that in a very large number of destructors, these important objects are only attained to a very limited extent.

In order to insure a perfect result:

(1) A high temperature must be attained; 1,300 deg. Fahr., is admissible, but 1,600 deg. to 1,800 deg. Fahr. is better. It is not sufficient to impart the desired temperature to the furnace gases after they leave the furnaces. Such devices as Mr. Jones' patent fume cremator (intended for this purpose), have done good service in their day in preventing the abominable emanations from the chimneys of old-fashioned low-temperature destructors; but at the best, such a device as a fume cremator is only useful in securing perfect oxidation of the gases and vapors distilled from the refuse, while giving no assistance whatever towards completing the other and equally necessary part of the process—namely, the reduction to innocuous clinker of the solid refuse itself. For this purpose it is essential that a high temperature must be kept up in the furnace itself, as well as in the flue.

(2) Having provided means for securing a high temperature in the furnaces and the flues, such arrangements must be made as will secure that the whole of the refuse and the whole of the products of combustion or distillation must be subjected to this high temperature, in presence of sufficient air, and for a sufficient length of time to insure complete oxidation of all combustible substances.

(3) It is also necessary that the products of combustion passing up the chimney must be as free as possible from solid matter, such as dust, which, although they may be so perfectly burnt as to be free from any taint of putrefaction yet their mechanical effect upon the leaves of trees and plants, upon the lungs of persons and animals, and upon clothing and furniture, are such as to become an intolerable nuisance, and a nuisance which has been proved in more than one instance to be actionable at law.

B. The destructor must be so designed as to involve the least possible expense in its working. To this end the handling of the refuse should be reduced as much as possible, though it must be borne in mind that the adoption of cumbrous and complicated mechanical feeding arrangements has hitherto been found to give no relief in the matter of labor; in fact, it has even involved additional labor, while at the same time such machinery is frequently very costly, both in construction and in upkeep and working charges. It must always be borne in mind that machinery working in the presence of large quantities of dusty and dirty material deteriorates very rapidly, and any machinery which is required about a destructor, particularly electrical machinery, must be so arranged as to be as nearly as possible boxed in and protected from dust. The author would mention, as an instance, the Shoreditch combined electrical lighting and destructor plant, where, according to the abstract of accounts, published in The Electrical Review, of May 27th, 1898, a large proportion of the total current produced appears to have been used on the works in driving fans, lifting machinery, etc. The author believes that this excessive expenditure of energy is due in a large measure to the extra resistance caused by the impossibility of keeping switches, brushes, etc., in proper order in presence of dust and dirt. In order to ensure economy, the safest points to bear in mind are that the refuse should be brought in the collecting carts, as near as possible to the charging holes of the furnaces, and the tipping arrangements should be such that a minimum of work is involved in properly charging the furnaces. It must also be remembered that considerable judgment is required in working a fire, and that judgment is not usually a faculty possessed by machinery. In order to obviate any difficulty in separating clinker from unburnt matter, and in order to insure as nearly as possible a continuous process in the furnaces, they should be fed at one end of the grate, and clinkered at the other, and the arrangements at the clinkering end should again be such as to involve the least possible labor in removing the clinker and to avoid altogether the necessity for breaking it up in order to get it through small openings.

C. In these days, people are not content with getting rid of the refuse in an inoffensive manner. It has been demonstrated that large quantities of heat are available from the combustion of refuse, and, therefore, it has become necessary that this heat should be utilized, and at present almost the only practicable method of utilizing the heat is in the evaporation of water. When it has been shown that in practical use eight tons of refuse will raise as much steam as one ton of good coal burnt under good conditions, and that it will raise that steam to the highest working pressures ordinarily adopted, there can be no doubt as to the advisability of providing sufficient boiler-room, and arranging a suitable use for the available power. In order to secure the best results, the boilers must be placed near enough to the cells to prevent any important loss of heat by radiation, but they must not be placed near enough to interfere with perfect combustion of

*A paper read in the Engineering and Building Construction Section of the Congress of the Royal Institute of Public Health recently held at Dublin.

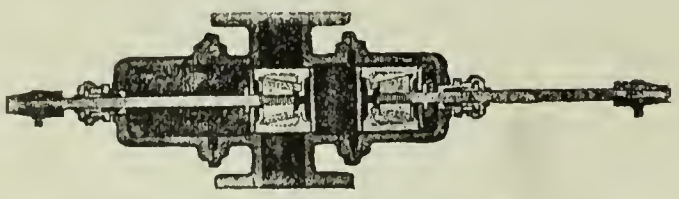
the gases, which is generally not completed until after they have left the furnaces and traversed a certain length of flue to insure proper mixing. It must be borne in mind that, even in boiler firing, with coal, any contact of the gases with comparatively cool cross tubes, etc., before they are perfectly oxidized, will check the combustion, and cause smoke, and it is obviously useless to mix any further oxygen with such unburnt gases after they have dropped below their natural temperature of combustion or "flashing point." It may here be mentioned that water-tube boilers are the most readily adapted to the requirements of a destructor station, although very good results have been obtained with other types, particularly Lancashire boilers. The comparative safety of water-tube boilers from explosion, and their general handiness and convenience, render them particularly adapted for working where the labor employed is not of a highly cultivated order, and generally in connection with these plants it is best to remember that, whatever apparatus is provided, it will probably have to be worked by stokers.

D. The solid matters resulting from the combustion of the refuse—e.g., clinkers from off the grates and fine ashes from underneath them—must be made use of for two reasons. first, if they are not made use of, they must be carted away and tipped to waste at a further cost. Second, they may be made a valuable source of revenue. It must not be forgotten that we have here another powerful argument in favor of high temperature destructors, the clinker from which will be completely fused, and will contain no combustible or putrescible matter, and will therefore be of a hard and sharp nature, in contra-distinction to the clinker from low temperature destructors, which is soft, friable and totally useless, and frequently even putrescible. It is no uncommon thing for such half-burnt clinker to take fire again, after being tipped into a heap, and thus to occasion serious nuisance. Assuming, however, that the clinker is going to be of a hard and useful character, we shall require machines for breaking it up, grinding it, and mixing it with lime, etc., to form mortar, and these machines must be powerful, massive and durable. Having thus briefly sketched the requirements of a destructor plant, the author will proceed to give some details of the manner in which these objects have been attained in one or two plants in the design and construction of which he has been concerned.

(To be continued).

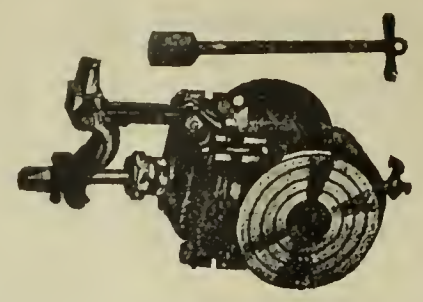
STRAIGHTWAY QUICK OPENING VALVES.

It has been demonstrated by practical boiler users, the makers of this valve state, that the most satisfactory way of arranging the blow-off is to use two cocks—one to open and close and take the wear and tear, and the second cock to make a perfect stop; but even with this arrangement it is necessary to blow down and remove the cocks to make repairs. With the duplex valve all these objections are overcome. The engineer can make the necessary repairs without blowing the boiler pressure down or removing the valve, as he has perfect control over it at all times, and can make repairs or renew the discs during working hours, with the pressure on, thus avoiding breaking joints or using a leaky blow-off, and saving night, Sunday or holiday work.



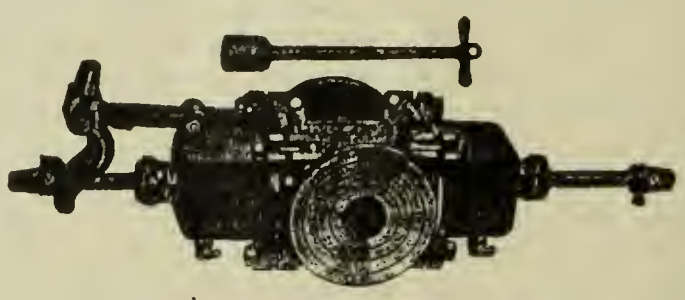
SECTIONAL VIEW.

The object to be attained by this device is to provide an easily operated and durable valve. There is contained within the valve a sliding cage, in which the discs and port are arranged. The valve stem connects with the cage, and a sliding motion is imparted to the cage and valve stem by a forked lever, which is pivoted to the valve body, and has suitable stops to arrest the movement of the cage at the proper place to bring the discs or port in the cage opposite the ports in the valve body. When the ports of the valve are in line with the ports of the cage, the cage covers the seats of the valve, and protects them from wear by scale and grit, when blowing off the boiler. With the cage in this position, the ports form a straight cylindrical passage through the valve, without any obstruction to the current while passing through,



JENNING'S SINGLE BLOW-OFF VALVE.

To close the valve, move the cage so the discs are placed opposite the valve ports, then they are expanded out against the valve seats by rotating the valve stem, which has a taper nut that engages with both discs, to expand or contract them.



JENNING'S DUPLEX BLOW-OFF VALVE.

To open the valve, the valve stem is rotated in the opposite direction to contract the discs, releasing the cage and allowing it to move with ease. The discs should be run all the way back to be sure that they don't drag over the faces of the valve seats and scar them, which will cause a leak. The valve stem is rotated by a special socket lever wrench, which engages with a hub on the ends of the valve stems. To throw the cage from point to point, the socket lever is placed on the hub (which is cast on the end of the forked lever), so as to make an extension and give greater leverage to operate the valve. These valves are placed on the Canadian market by Garth & Co., Craig street, Montreal.

ELECTROLYSIS IN GAS AND WATER PIPES.

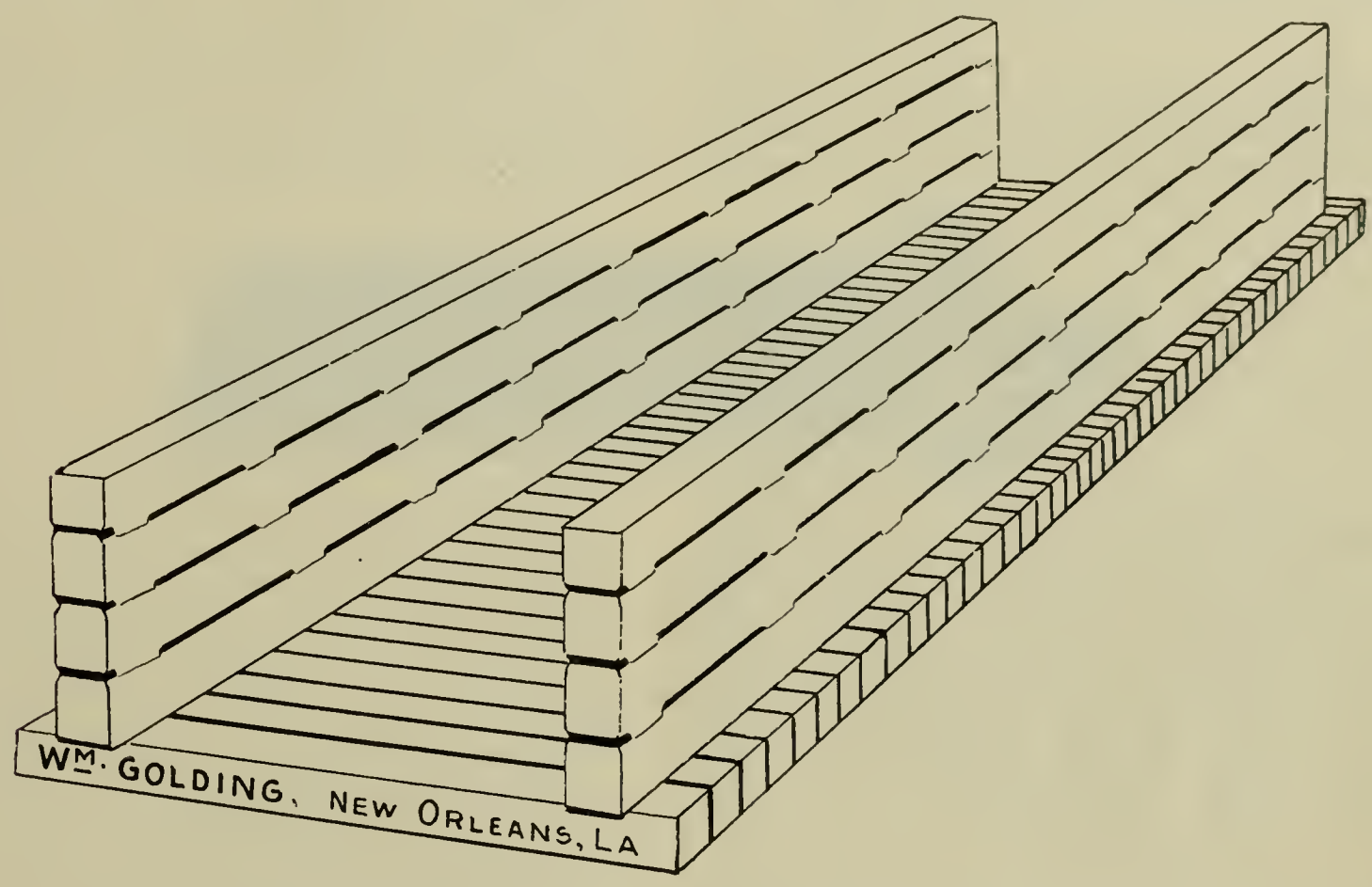
The electrolytic effects of the currents leaking from street car rails to the metallic pipes near them formed the subject-matter of two papers recently read before the American Institution of Electrical Engineers. The first was by A. A. Knudson, entitled "An Electrical Survey in the Borough of Manhattan, New York," and the other was on the "Electrolysis of Cast-Iron Water Pipes at Dayton, Ohio," by Harold P. Brown. In both cases great damage was proved to have been done. It appears from the tests made by Mr. Knudson that an open-conduit system, or one in which an insulated metallic return is used, effectually confines the current to the conductors provided for it. H. P. Brown, in conclusion, offers the following comments and practical suggestions on the matters generally to water and gas engineers: Do not imagine because your pipes are not leaking and bursting that they are safe from electrolysis. If the electrical conditions are against them, they are getting weaker day by day. Do not antagonize the railways the moment that the subject of electrolysis comes up. The best course for all concerned is to take mutual action. Do not put down any more lead or wrought-iron service pipes, as these are the first victims of electrolysis, and their replacement means ruin to pavements. Use instead wooden pipe, banded with a close spiral of hoop iron and covered heavily with asphaltum. This will stand the heaviest pressure in use, and is not affected by electrolysis, since the hoop iron is low in conductivity, and is not electrically connected at the joints. Its cost is said to be reasonable, and it has a successful record of many years' service. Use the same kind of pipe for new mains in any district in which a railway power-house is likely to be erected, and heavily paint the lead caulking of cast-iron mains, using asphalt or petroleum wax. In the danger district along the lines of electric roads, and on intersecting streets, put into your water and gas mains two or more consecutive lengths of these wooden pipes so as to break the electrical continuity of the mains, and thus make their resistance greater than that of the rails. Fill in the space around them with broken stone, and connect with drain if possible. Midway between the wooden sections on each main attach insulated pilot wires leading to a central office. Connect similar wires to the rails nearest the pipe wires and

make daily electrical tests at times of heavy load. If any section shows positive to the rails cut it at once into smaller sections, and call upon the railway to rebond its line upon that street. This, with the proper electrical management of the railway feeder wires and apparatus, will effectively protect your mains.

A FLOATING DRY DOCK.

Editor CANADIAN ENGINEER.

The annexed sketch illustrates a floating dry dock, designed by me several years ago, the feature of which consists of assembling a number of steel pontoons, aggregating sufficient lifting capacity, and in securing same in such manner as to form a solid structure, and yet permitting the removal of each pontoon for painting and repairs.



For a dock of this type, capable of lifting twelve thousand tons, the length will be five hundred feet, and the inside width eighty feet. There will be forty pontoons, placed side by side, yet two and one-half feet apart, each ten feet wide by twelve feet deep, and one hundred and twenty feet long. There will be eight submerging tanks, constructed precisely the same as the pontoons, which will be placed one upon the other as shown, yet being separated by I bars to facilitate painting. These tanks will be five hundred feet long by ten feet square, each. When the pontoons and submerging tanks are placed in the position shown in the sketch, they will be secured by suitable stirrups, which will pass entirely around each pontoon, and extend to the top submerging tank, thus securing and combining the pontoons and submerging tanks as one structure. The pontoons will be divided into three compartments, each forty feet long. To sink the dock, water will be admitted into the two end compartments, the centre compartments being barely sufficient in the aggregate to balance the entire weight of the dock. When the pontoons are filled, water will gradually flow into the submerging tank through suitable controlling valves, which will be closed when the required depth is reached. For removing the water from the pontoons, there will be placed on the outside ends of same eighty pumps of proper type and size. These pumps will be operated in four sets of twenty each, on one shaft, at each quarter of the dock. The motive power will be electricity, supplied from a power-house conveniently located on land. No water will be admitted to either of the top tanks, in which there will be sufficient reserve to float the entire dock, even should all valves be left open. The objects sought to be gained in this type of dock construction are economy of construction, simplicity in operation, facility of preservation, and absolute safety. Total weight of material is 6,000 tons; net lifting capacity is 12,000 tons; gross lifting capacity is 18,000 tons. It is estimated that a dock of this type and capacity can be constructed and set up, ready for operating, for the sum of $400,000.

WM. GOLDING.

New Orleans, La.

HIGH LEVEL PUMPING STATION, ST. JOHN, N.B.

The following description of the new high level pumping-station in St. John, N.B., is taken from the annual report of the waterworks department, made by the engineer in charge, W. Murdoch, C.E.

Under an order passed by the Common Council on July 15th, the work of preparation for the new pumping station at Silver Falls was commenced on August 2nd, by a party of men being sent in to clear the land. It is traversed by Little River for a distance of 475 feet, and comprises the two upper successive porches of Silver Falls, which are 275 feet apart. The lower one of these falls, which is but 140 feet distant from No 3 leading main, drops into a pool whose surface is sixty feet below the level of the head of the upper fall. The minimum flow observed here at the dryest time was 135 cubic feet per minute. The maximum has not been gauged, as it is often a raging torrent. A stone dam, sixty-five feet in length, and varying up to eleven feet in height, has been built on the upper fall, and a cast-iron flume extended therefrom to the crest of the lower fall. This flume is 24 inches in diameter for a distance of 200 feet, and reduced to 15-inch and 12-inch pipe the remainder of the way. The large pipe was old stock left over from the laying of No. 3 main, 25 years ago, when it was charged to that main.

A frame building is placed at the lower fall, the floor being ten feet above the pool already named. This is for the turbines, and through it the twelve-inch flume will extend to supply the turbines and terminate with a gate valve of the full size, discharging into the river. The two turbines were made by J. C. Wilson & Co., Glenora, Ontario. They are eight-inch horizontal double turbines, with draft tubes, and can be worked either at half gate, when each will develop twelve h.p., or at full gate, when double that power is to be realized. This will enable the obtaining of the full efficiency of a wheel, when only enough water flows to give twelve horse-power, and in an emergency, if such emergency occurs when there is water enough in the river, 48 horse-power can be had. But the main object in having two wheels is to hold one in reserve while the other is in use, so that there be no stoppage in the auxiliary service when once begun. Another precaution against stoppage is that in the rope transmission between the turbines and the pumps, four independent ropes are to be used, each with its own tightener, the whole to be

enclosed in a shed reaching up the slope (which rises at an angle of 39 degrees), to pump-house. The pump is being built by the Northey Manufacturing Company, of Toronto. It is specified to be a double-acting power pump with a capacity of 33 imperial gallons per revolution of the crank shaft. A brick building, 16 x 26 feet eight inches, has been built for its reception, at a distance of 15 feet south of the pipe line. As soon as the weather permits, after the arrival of the pump, the main pipe will be cut and a branch led therefrom to the suction of the pump. From the delivery another pipe will return to the main, and between these two branches will be placed a check valve with balanced gate, set in such a way that when the pump is in operation, the valve will close, and the water be driven onward to the city, but should the pump stop, the valve will open and allow the water to gravitate as it does at present, delivering only into the basements of the highest houses.

THE ARMSTRONG CUTTING OFF TOOL.

The Armstrong cutting off tool (patent applied for), is made in seven sizes and is especially adapted for the economical use of self-hardening steel. The latest addition to the Armstrong tools is the cutting off tool, illustrated herewith. This

tool will cut off and keep right on cutting off. It stands the racket of constant work, and this is one of the chief points of difference, its makers state, between Armstrong tool holders and imitations of their tools. The holder and bolts are made of steel and hardened. The cutters are made of special grade self-hardening steel, rolled beveled on both sides, giving the proper clearance to ensure a clean cutting tool. The blade requires grinding on the cutting end only. Aikenhead Hardware Co., Toronto, is the Canadian selling agent.

JOHN GALT, C.E.

John Galt, C.E., who was appointed city engineer of Ottawa, Ont., Nov. 14th, and entered upon his new duties Dec. 1st, was born at Kilmaurs, Ayreshire, Scotland, Sept. 23rd, 1852. Although he is comparatively young, his experience as an engineer has been varied and thorough. It has included the construction of railways, canals, waterworks, drainage systems and public improvements of all kinds. Mr. Galt was educated at the Kilmarnock Academy, and, after obtaining a Government science scholarship, he took a full university course, and graduated in engineering at the universities of Glasgow and London. For a time he followed his profession in Glasgow, being engaged in some of the large railway improvement schemes, and was also superintendent and lecturer in the Government science schools in Glasgow for several years. In 1878 he went to the United States, where he was engaged in railway engineering on the Southern lines for three years. Upon coming to Canada in 1881, he wae appointed general manager of the Boiler Inspection and Insurance Company of Canada, retaining this position for four years. Since 1885 he has been engaged as a consulting engineer, and has been very fully employed during that time chiefly upon municipal work.

TRADE IN THE YUKON.

The principal traders in the Yukon, writes a correspondent of THE CANADIAN ENGINEER, are: The N.A. Trading Co., and the Alaska Commercial Co. These are the two great trading companies, who up to the past season have had almost a monopoly of the local supply trade. They are United States companies, but none the less to be cultivated, as already they are purchasers of Canadian goods. Your letter suggests two very great lacks in our trade circles to-day. One is the fact that our merchants have not yet appreciated the advantage to Canadian trade of the Dawson or local demands. Another is in the reminder of the character of Klondike trade. The average person is half inclined to doubt that Dawson has any demands for textiles, etc. There is a surprise in store for our wholesale merchants in the character of the supplies needed at Dawson, especially this year. People for many months in the year, at least, dress there as here, except that the social laws are less exacting. In the coming time, however, there will be a growing demand for all the luxuries of metropolitan life, and there is a field open in meeting this demand. But the change will come, and we ought to take due advantage of it. With next year will come closer and quicker connection with that country, and following cheaper transportation will be increased demand.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

TWELFTH ANNUAL BANQUET OF TORONTO NO. 1.

The twelfth annual banquet of C.A.S.E., Toronto No. 1, was held at the Walker House, Toronto, on Nov. 23rd, the president, Chas. Moseley, in the chair. The very efficient committee in charge of the banquet arrangements were: A. M. Wickens, Albert Slute, J. G. Bain, J. Bannan, W. C. Tait, J. Marr, chairman; Geo. Thompson, secretary, and Geo. Mooring treasurer. How thoroughly the committee had performed their duties was augured by the large number of members and their friends and guests who assembled a little before 9 o'clock in the corridors of the Walker House, where smiles and jests and pleasant greetings alike to old friends and new acquaintances showed that the stationary engineers need not at least study the arts and graces of hospitality, as they were one and all past masters in that important subject already. The good work of the committee was in evidence throughout the evening, which passed without a single flaw, from the entry of the crowd of nearly two hundred into the spacious dining room, through the well served dinner and the subsequent speech-making and music till the last good-night had been said. The menu was as follows: Spanish olives, celery. Soup—Tomato, aux Croutons. Fish—Boiled Columbia river salmon, Hollandaise sauce. Pommes de terre, a la Parisienne. Entrees—Chicken croquettes, a la Richelieu, escalloped oysters, a la Baltimore. Boiled—Leg of Southdown mutton, caper sauce. Roast—Ribs of beef, with horse radish, young turkey, cranberry sauce. Vegetables—Mashed potatoes, green peas, sugar corn. Game—Haunch of venison, with jelly. Pastry—English plum pudding, brandy sauce; apple pie, lemon meringue pie, raspberry tart, assorted cakes, wine jelly, rock punch. Dessert—Blue-basket raisins, apples, oranges, bananas, filberts, almonds, Malaga grapes, MacLaren's imperial cheese, gorgonzola cheese, tea and coffee.

Before the toast list was reached the assembly had the pleasure of listening to a piano solo by Mr. Fisher, and then the president, Chas. Moseley, in a short speech welcomed the members and their guests to the twelfth annual banquet. After expressing his pleasure at the large attendance Mr. Moseley referred to the growth of the order, and its most satisfactory condition, not only as regards Toronto No. 1, but the other branches as well. The chairman then proposed the toast "The Queen," which was drunk with an enthusiasm which amply demonstrated the loyalty of the engineers of Toronto. W. G. Blackgrove then sang "Soldiers of the Queen," with fine effect, his rich voice stirring the audience to a fresh outburst of patriotic cheers. As an encore Mr. Blackgrove sang "Out on the Deep." The names of Mayor Shaw and Ald. F. Woods were coupled with the toast "Toronto, Our City." The mayor in responding spoke of the present prosperity which is prevailing in Toronto in contrast to the years of depression just passed through. He believed the present expansion would be permanent, and instanced the growth of several of our city's industries, and the entrance into the city of firms formerly doing business outside. He promised that efforts would be made to gain for Toronto some of the general benefit resulting to the country from the enlargement of the St. Lawrence canals. The mayor expressed his sympathy with the efforts of the committee on legislation to secure official recognition of the Examining Board of the Society. Ald. F. Woods confined his speech to an appeal for support in the approaching municipal elections on

the score of his being a member of the Typographical Union, and the work he was doing to advance its interests in the city council. The toast of "Canada, Our Country," was proposed amid cheers, and the singing of patriotic songs by Messrs. Fox and Grant, the toast was coupled with the names of Geo. Anderson, manager of the Royal Oil Co., and A. M. Wickens. Mr. Anderson spoke of the growing prosperity of Canada and congratulated the association on the fact that its name of "Canadian" was so truly an indication of the spirit of loyalty in the society. He rejoiced in the fact that Canada is now in closer relations with Great Britain, and is now admitted to the councils of the nation. He pointed out that there was great room for development in the science of mechanics, and that there was therefore room for engineers not only to inform themselves as to what is already discovered, but to make original investigations. A. M. Wickens was proud of his Canadianism, and of his allegiance to "Our Lady of the Sunshine." He referred to the progress of the Technical school, and the good influence of the association in helping it along. The toast of the "Manufacturers," was responded to by C. L. Weeks of the General Engineering Co., J. M. Sinclair, manager Eureka Mineral Wool Co., and Jas. McLaughlin, of the Queen City Oil Co. Mr. Weeks spoke of the keenness of competition in business at the present, and the necessity of taking advantage of all aids to increase production. Mr. Sinclair made a brief speech congratulating the association upon its growth and progress, and upon the good times in the country at large, which permitted in very many industries the employment of day and night shifts. Mr. McLaughlin made what was quite one of the best speeches of the evening, in which he spoke of the fact that manufacturing and trade had been the source from which freedom had come into the state in the old days. He spoke of the unrivalled facilities which Canada offers to the manufacturer in every department of trade in her wonderful natural resources. Formerly Canadian products had to be sold as from the United States, now in many lines the name Canadian adds to the price. Mr. McLaughlin in closing referred to the great progress the oil industry was making in Canada, as witnessed by the building at Sarnia of one of the most complete refining plants on the continent in the past year. "Educational Interests" was responded to by J. Galbraith, principal of the School of Practical Science, Toronto, and A. G. Horwood, secretary of the Toronto Technical school. Mr. Galbraith spoke of the growth of the school over which he presides, and stated that he believed that the science of mechanics as applied to the steam engine was very near its final development, and that little further in this department should be looked for. Mr. Horwood asked the aid of the members of the association in advancing the interests of the Technical school. Bert. Harvey here sang a most laughable and clever medley, and as an encore, "I Want to Join the Army." The toast of the Executive Council was responded to by E. J. Philip, G. C. Mooring, R. C. Pettigrew and A. E. Edkins, who each made a few appropriate remarks. "Sister Societies," was responded to by J. Dixon, Toronto No. 18, and R. Mackie, president of the Hamilton branch of the association, and J. R. Nuttley, Waterloo, who all expressed pleasure in the growth and prosperity of Toronto No. 1. The "Press" was responded to by the representatives of The Electrical News and The Canadian Engineer. A feature of the evening much appreciated by the gathering was the comic singing of J. Fax, whose efforts were received uniformly with tremendous applause. The following were present: A. E. Edkins, A. G. Horwood, R. C. Pettigrew, Ald. F. H. Wood, Mayor Shaw, Chas. Moseley, G. C. Mooring, Chas. Rust, C.E., Geo. Anderson, Prof. Galbraith, Alex. Fraser, John Dixon, A. Lang, Geo. May, Jas. McLaughlin, W. McGee, J. M. Dignum, W. Sherman, A. Doyle, J. Queen, G. W. Gore, W. Sutton, Geo. Bradley, D. McBain, F. Auchlincloss, Chas. Smith, R. Gondy, T. H. Dryden, Sam Thompson, A. Boyce, James Fax, W. Black, W. Keating, A. R. Taylor, E. Terry, F. Barton, Bert Harvey, J. Edward Fisher, J. G. Bain, W. C. Tait, Jos. Bell, W. Bourne, G. Evans, H. Butcher, J. Grout, Fred. Kirk, F. H. Fulshell, R. Galt, A. Richardson, R. Mercy, Joseph Hughes, G. Clatington, Wilson Phillips, M. B. Tullman, John Gourley, Angus McMaster, W. Dawson, D. Hunt, J. H. Pringle, Sam B. Mills, A. J. Woodward, W. Stevens, T. Hope, Geo. Mackie, Robert Mackie, J. Ironsides, Jas. Bannan, Albert Slute, E. J. Philip, C. L. Weeks, Jas. Sitster, J. Ennicht, W. McLean, J. Carson, A. H. Granger, John Emms, Jas. Mooring, W. Pierson, G. Graham, J. Barrow, J. Everett, A. Backer, F. Day, J. Day, J. McLeary, A. Travin, F. Barron, B. Hallen, W. Truckman, E. Ireland, R. Davies, D. McEvoy, A. W. Smith, J. Spencer, J. Prestege, R. Johnston, R. Broughall, E. Dudgeon, S. Graham, J. Fensom, W. Mashinter, J. S. McKay, G. W. Grand, J. Fisher, H. W. Sayton, G. Thompson, W. Mooring, J. Nicholson, J. Granger, A. J. McDonough, E. Ash, W. E. Archer, W. J. Webb, J. S. Anderson, J. Huggett, A. T. Robb, T. Eversfield, E. G. Fowler, G. B. Cowers, J. R. Nuttley, J. C. Long, J. M. Sinclair, W. L. Outhwaite, C. Scott, A. Scott, F. Vantown, T. Hodgson, J. Bannan, M. Burns, J. Fox, W. S. Butler, S. Butler, J. R. Bennett, W. G. Hamner, S. Woodhouse, B. Campbell.

WIND PRESSURE, ACTUAL AND ESTIMATED.

Editor CANADIAN ENGINEER.

In a recent issue of the Scientific American, in an editorial on Sir T. W. Barry's remarks, at the meeting of the British Association at Bristol, anent the want of agreement between the results and conclusions of experiments on a small scale, and the working of nature on a more extensive basis, there is an allusion to the fact, among others, that as far as wind pressures are concerned, and while at the Forth bridge in Scotland, 58 lbs. to the square ft. were allowed for, based on the indications of ordinary anemometers, the result of an experiment on a 300 ft. surface, under like conditions, showed a falling off of very nearly 40 per cent. Again, at the "Tower bridge," London, while conclusions, based on anemometrical readings, indicated a pressure of 6 to 9 lbs. per square ft., experiments conducted on the bascules of the bridge, whose area is 5,000 ft., showed only from 1 to 1½lbs. wind pressure, under absolutely similar conditions. These glaring differences are accounted for on the assumption that a gale of wind presents areas of maximum pressure, which are far in excess of the average pressure. Now, I am in a position to say that this mere surmise of the editor of the S. A., is a matter of fact. Now to the proof: While in a gale at Quebec, the galvanized iron roof sheeting of four of the octagonal kiosks on Dufferin terrace remained untorn, which it had been on other occasions of severe gales; the fifth kiosk, situated in the midst of the other four, not only had its sheeting curled up and twisted and torn off, but the entire roof framing, all of cast iron, and bolted together, was bodily wrenched from its eight supporting columns, the confining bolts of each of which were broken off, and the whole roof, some 2½ tons in weight, carried up a height of say 40 ft., and over a distance of some 300 ft., and deposited in a broken and demoralized condition on the glacis in rear of the terrace. Now, it is evident that in this case there was within the general stream of easterly wind blowing up the St. Lawrence and striking the terrace, an intensified current which struck the demolished structure; a stream within a stream, so to say, as with the "Gulf Stream" in the ocean. I reduced the thing to figures at the time (some ten years ago, or less), and found that while the anemometer at the Quebec observatory on the occasion indicated only 59 lbs., the stress on the roof of the kiosk, thus to tear it away and hurl it to such a distance, must have had a cyclonic force of not less than 100 to 120 lbs to the square foot. The same thing occurred in the United States a few years ago, when as I then showed in a letter on the subject, published in the Engineering Record, of New York, while the general force of the wind-storm was insufficient to do the mischief, there must have been within the moving river of air, the rush of air in motion, a more intensified stream which struck and overthrew two of the 500 ft. spans of the Jeffersonville bridge, each of which weighed not less than 1,000 tons.

But this does not explain nor in any way account for the difference herein-above alluded to, of the effect of wind currents on areas of varied extent. I think, Mr. Editor, I can account for this. It will be remembered that I was the first, at the time, and for some months before the attention of the world at large had been called to the apparent paradox, to explain (and your journal to publish), the so-called nozzle mystery, which I did by showing that the issuing circumferential jet of water carried with it by

friction, the water in the rear of the hall, thus creating a vacuum against which the pressure of the atmosphere reacted to keep the ball in place. Now precisely the same thing happens with the anemometer, and the more so the larger its surface or extent; the wind passing around its periphery sucks out the air in rear of it, creating a vacuum against which the atmosphere pressure on the opposite side reacts.

It will be noticed that while in the case of the Forth bridge, as stated, the larger area of experimentation, 300 ft., gave a wind pressure of only 40 per cent. less than that indicated by the ordinary anemometer; in the case of the Tower bridge, the 5,000 ft. area of the bascule experimented on, reduced the anemometrical pressure of from 6 to 9 lbs., down to from 1 to 1½ lbs.; or not only by 40 per cent., but by from 400 to 600 per cent—this difference being due to the proportional circumferential or linear peripheries of the surfaces experimented on, in comparison with the areas at play, the peripheries varying only as the linear dimensions, while the areas varied on the squares of those dimensions.

For instance, if the anemometer were a foot square, its area would be but one ft., while its periphery were four ft., or the area to the circumferential dimensions, in the proportion of ¼ to 1. With a surface of 10 x 10 ft., the area would be 100 ft., and the periphery 40; area to circumference as 2½ to 1; again, if the surface played on by the wind were 100 x 100 ft., the area would be 10,000 sq. ft., while the periphery were only 400 ft., or the ratio of area to circumference, that of 25 to 1, leaving the wind to act on or around edges of 4', 40', and 400', respectively, while the atmospheric pressure were exercised against areas of 1,100 and 10,000 sq. feet, and thus explanatory of the fact that the greater the area acted on, the greater the reduced percentage of pressure indicated by the larger surface.

C. Baillairge,
Consulting Engineer, Que.

October 7th, 1898.

Industrial Notes.

James & Reed, Perth, Ont., are enlarging the output of their machine shop.

The new Methodist church, at Madoc, Ont., will be of brick, and cost $12,000.

W. W. Carter is making a large extension to his stave and hoop mill at Fesserton, Ont.

The Pembroke, Ont., Milling Company will build an elevator close to the P.S.R. track, in Pembroke.

The new Intercolonial Railway grain elevator, at Halifax, N.S., is now being built by M. E. Keefe, of Halifax. The contract calls for its completion by January 1st next.

Robert Murray has his new machine shop at Rat Portage, Ont., finished. It is connected with Richard Hall's new marine slip. The entire plant will cost upwards of $10,000.

The Berlin, Ont., Brush Co., will move to Waterloo, Ont., as the former town failed to raise the $1,000 by private subscription that it was proposed to lend the company.

The boiler and machine shops of the British Columbia Iron Works, Vancouver, B.C., are starting up after being idle for many months, owing to the financial embarrassments of the company.

The Canadian Rand Drill Co. requires larger premises for its business, and is asking a free site and a bonus of $20,000 from the city of Sherbrooke, Que., where it has been located for some years.

At a meeting of the council of the town of Farnham, Que., a Montreal furniture manufacturer offered to start an extensive furniture factory here, in consideration of a bonus of twenty thousand dollars.

W. J. Finlay, of Lawrence, Mass., brother of J. D. Finlay, superintendent of the Toronto Paper Co.'s mill, at Cornwall, Ont., has been appointed manager of the mills of the Sturgeon Falls Pulp Co., Ltd.

H. S. Dowd will build a large oatmeal mill at Quyon, Quebec.

E. Gilbault, St. Boniface, Man., has purchased the barb wire works on Lombard street, Winnipeg, and will run the establishment in conjunction with his tin box factory, which will be moved from St. Boniface.

Among other matters of interest in the annual report of the City Engineer of Toronto, is the statement that a new bridge on the Humber river, at the Lake Shore road, will be necessary next spring. Estimated cost, $13,000.

A. A. Scott, Toronto; T. B. White, Kolapore, Ont.; W. Johnston, J. L. White, Heathcote, Ont., and Lizzie K. Scott, Toronto, have applied for incorporation as The Forest Product Company, Ltd. Chief place of business, Toronto; capital, $40,000.

Pierre Mahy, a window-glass blower, of Rensart, Belgium, states that a group of skilled window-glass workers from Belgium, desire to migrate to Canada, and work at their trade here. Besides manufacturing window-glass, all sorts of fluted and cut glass could be produced.

J. H. Chewitt, president of the Rossin Hotel Company, Toronto, has announced that it has been determined to make improvements to the hotel, amounting to $150,000. As soon as the weather will allow, work will be begun on the lower floor entrances. The plans include an addition.

The Canadian Oil and Coal Company, Ltd., has applied for a Dominion charter to locate and develop petroleum wells and coal mines. The chief place of business is Montreal; capital, $1,000,000; incorporators, W. Strachan, J. W. Pyke, B. Shepherd, G. H. Meldrum, Montreal; Hon. A. W. Cole, Albany, N.Y.

A by-law to fix for ten years the rate of taxation of the Ontario Rolling Mills Company, Hamilton, Ont., at $1,200 a year, in consideration of the establishment by it of a horseshoe factory, in the building erected for the manufacture of cut nails, but unused for several years, has been introduced into the Hamilton city Council.

The Taylor Hydraulic Air Compressor Company has, it is stated, completed a sale of its rights for the greater portion of the United States, the price being $200,000. This sale has been effected as a result of negotiations pending for some time, and was made after a thorough inspection of the working of the hydraulic air compressing plant at Magog, Quebec.

The Robb Engineering Co., Amherst, N.S., has received an order from New York for two 300-h.p. engines for an electric railway in Australia. They are tandem, compound, side crank pattern, and the dynamos will be direct connected. This company is working up a considerable export trade, having shipped during the past few months one 300-h.p. engine to England, three 125-h.p. to the Isle of Man, three 125-h.p. to Spain, and one 125-h.p. to Newfoundland.

The St. Thomas, Ont., Brass Co., which has erected a foundry and warerooms, has for proprietors the owners of the Buffalo Brass Co., Ltd. H. H. Hewitt is the president, and they have several branch establishments throughout the United States. The chief matter for comment about the new Canadian firm is that it has settled down to business without the customary period of bonus hunting, and evidently proposes to do business because business is profitable, not because the doing of business may be the cause or the receipt of unearned profits, as in the case of a crossing-sweeper's "tips."

Sissiboo, N.S., Pulp Co., on the river of that name, has four turbines, capacity, 17,000 horse power, and has, states the Weymouth, N.S., Free Press, four grinders, three wet machines, two hydraulic presses, a smaller packing press, and the necessary repair shops, and an electric light and steam heating plant. The mill works day and night throughout the greater part of the year. Scarcity of water in certain seasons sometimes necessitates a suspension. This difficulty, however, has been largely overcome by the construction of reservoirs at convenient stations on the upper part of the river. Some twenty-five tons per day is the average output of the mill, which consumes annually about 3,000 cords of spruce. Employment is furnished to twenty-six men.

A fifty barrel flour mill has been established at Grenfell, Assa., by a local company.

The Bailey Cutlery Co., Brantford, Ont., is now an established industry, having started up November 4th.

Parrish, Lindsay & Co. will erect elevators at Argue and Barber, Man., new towns on the Belmont, Man., extension of the Northern Pacific.

The Ottawa Stock-Yards Abattoir Company, Ltd., has been incorporated, with a capital of $50,000, to carry on an abattoir and stock-yards business.

The Massey-Harris Co., Brantford, Ont., has recently installed a very complete system of fire protection, including a pump with a capacity of 1,500 gallons per minute.

Two new elevators are being built at Arden, Man. One for John Davidson & Co., the other for R. C. Ennis, both of Neepawa. They will be of 25,000 bushels capacity each.

John Reeb & Sons, Port Colborne, Ont., have bought out the Welland, Ont., gas company, and have assumed control. The price paid is said to be $17,000, which includes the five wells and the plant.

Sarnia, Ont., is unable to accept a tender to pipe the streets and supply gas in the town at 25 cents per thousand, as it is found that the present gas company's charter confers an absolute monopoly.

The town of Barrie, Ont., carried a by-law to raise $100,000 to purchase the existing waterworks plant and make extensions to suburban parts of the town. The vote was taken November 7th.

At a public meeting held in Ottawa, Ont., last month, resolutions were passed urging the establishment of technical schools, and the Ottawa Board of Trade has appointed a committee to move in the matter.

The degree of B.Sc. (Bachelor of Science), which it is proposed to substitute for that of B.A.Sc. (Bachelor of Applied Science), now granted at McGill University, will be much more easily understood by the public.

We understand that the Caledonian pottery of Campbell & Purvis, St. Johns, Que., has shut down for a short time. The works of the Canada Stone Chinaware Co. also continue closed, pending the negotiations of Lavoie and Aube with the directors in Paris.

At a meeting of the People's Heat and Light Company, Halifax, N.S., November 16th, it was decided to issue $100,000 worth of second mortgage debentures, bearing interest at 5 per cent., repayable in 15 years. This is to meet the cost of the new plant.

The Laurentide, Que., Pulp Co. has decided to purchase the Grand'mere falls from the government, together with several islands above and below. The matter has gone into arbitration, and the arbitrators are Stewart Howard, C. E. Gauvin, and S. P. B. Casgrain.

Charles C. Dodge, Samuel F. Roop, Warren E. Roop, Oberlin A. Rogers, Ezekiel M. Barteaux, George E. Hutchinson, Edwin S. Dodge, Angus J. Morrison, and Thomas R. Jones are the provisional directors of the Middleton, N.S., Wood-working Co., Ltd., which will carry on a general wood manufacturing business: capital, $10,000.

The working force of E. Leonard & Sons, engine and boiler makers, London, Ont., has, says a special correspondent of the Toronto Globe, in a recent issue, been increased nearly 50 per cent. At the same time much overwork has been found necessary to fill orders on hand. Improved machinery has also been put into this establishment, so as to turn out heavy engines for electrical purposes.

Of Dundas, Ont., a correspondent of the Monetary Times says in a recent issue: "There is decidedly more activity in business generally, especially since the Toronto, Hamilton & Buffalo Railway reached the town one year ago. The old established firm of John Bertram & Sons were never more fully employed, and they employ 225 hands. The senior member of this firm has been in business in Canada since 1861, and the present tool works cover 60,000 square feet of space. There is now being added a tool shop, covering 10,000 feet additional, to erect machinery for heavy work, besides a new branch for paper mill machinery.

The Grand Trunk Railway freight business is increasing so rapidly that the company is now considering the question of erecting another new elevator at Midland, Ont.

The ratepayers of Oshawa, Ont., will shortly vote on a by-law to raise funds to build the waterworks and sewage disposal system, for which John Galt, C.E., the new city engineer of Ottawa, Ont., has made the necessary plans and estimates.

A public meeting was held in St. John, N.B., a short time ago, and the establishment of a pulp mill at Woodstock, N.B., was discussed. A committee has the matter in hand, and an expert from the United States has been called in. A forty ton mill is contemplated.

The property of the Gardner Tool Co., Ltd., Sherbrooke, Que., in liquidation, was sold November 15th at auction. The stock, valued at some $15,000, was purchased by William Farwell, manager of the Eastern Townships Bank, who also bought the real estate at $600, subject to the claim of the city of Sherbrooke of $18,000.

J. Dobson, C. J. Webb, Philadelphia; R. Peverley, New York; R. T. Hopper, R. D. McGibbon, Q.C.; T. C. Casgrain, Q.C., and W. F. Robinson, Montreal, are to be incorporated as The Beaver Portland Cement Company, Ltd., to manufacture Portland and other cements, and pressed brick, drain pipes, etc.

The Fossil Flour Company, operating at Castlereagh Lake, says the Truro Guardian, has been working all summer, with a goodly number of men, the output being about ten tons per day. The coarser grades of the material are largely used in the manufacture of rubber for fireproof packing. The finer grades are used in various arts and sciences.

An Ontario charter of incorporation has been granted to the North Shore Timber Company, of Port Arthur, Ont. This company is the outgrowth of the firm of Hazlewood and Whalen, pulp wood contractors. The new company is capitalized at $60,000. The members of the company are P. Weidner, E. W. Voight, O. L. E. Weber, A. K. Kiefer, of Detroit, Mich., and R. A. Hazlewood and James Whalen, of Port Arthur. The object of the company is to carry on a general lumbering and pulpwood business.

The Dominion Vinegar Works, Hamilton; the Hamilton Distillery Vinegar Works; A. Haaz & Co., Kingston; S. Allan, Norwich; William Wilson, T. A. Lytle & Co., and the Badgerow, Scott Co., of Toronto, have united and formed a trust. The trust is known as the Wilson-Lytle-Badgerow Company, of Ontario, Limited, with a capital stock of $600,000. William Wilson, Toronto, is president, and William S. Scott, of Badgerow & Scott, is secretary-treasurer. A vinegar factory, for the trust, is being built at the corner of Front street and Spadina avenue, Toronto, at a cost of $150,000. Orr Bros., Toronto, have the contract.

Recent cable despatches in the Montreal Star stated that British capital for iron shipbuilding in Nova Scotia was to be forthcoming, and that the plant would be established in Cape Breton, where cooperation with the Dominion Coal Company would be assured. The iron ore is found in great quantities on the southern cost of Cape Breton, and this, it is said, will be treated at a smelter erected at Louisburg, C.B. The erection of a shipbuilding plant would follow the development of the iron works. So far, the Dominion Coal Co. has not been approached by anyone with any proposition of this kind, though it writes us that it would be glad to cooperate with any company undertaking such a development.

A. W. Campbell, Provincial Instructor of Roadmaking, has returned from Washington, where he has been attending the Municipal Improvements Convention. A great number of subjects was discussed by experts from the United States and Canada, on sewage systems and disposal, waterworks, construction of pavements and roadways, laying out of parks, and tree planting. "The ideal roadway," he said, "was constructed of asphalt blocks, of which many miles had been laid in New York, Boston, Baltimore, and Washington. Sprinkling asphalt at night is the proper method. It prevents the dust and does no injury, but it should be well flushed, in addition, once a week."

There is some prospect of a pulp mill being started at Bathurst, N.B.

The Andover, N.B., waterworks are completed, and the water has been turned on.

Revelstoke, B.C., is to have a sawmill with a cutting capacity of from 25,000 to 35,000 feet per day.

The Watson & McDaniel Co. report a large and increasing demand for the new Jennings Blow-off valves.

The stone work on the piers and abutments of the new inter-provincial bridge, Ottawa, Ont., is very near completion.

The city engineer, Hamilton, has reported in favor of laying the new $160,000 water main by day labor instead of contract.

W. H. Fowler proposes to at once erect a flour mill of 400 barrels daily capacity near the head of Rodney wharf, St. John, N.B.

The Sheffield Cutlery Company, of Montreal, has been incorporated in Quebec; capital, $10,000. The purpose is to make cutlery.

The property of the Ontario Wind Engine and Pump Co., Toronto, has been exempted from taxes for ten years from January 1st, 1898.

The vote on the $50,000 by-law for the purchasing of the Waterloo, Ont., waterworks plant from a private company was voted down by the ratepayers November 21st.

On November 22nd the entire long span between the piers of the Ontario end of the bridge across the Ottawa at Portage du Fort, Que., suddenly gave way, and fell into the river.

It is now an assured fact that at least two of the big saw mills at the Lake of the Woods will be removed to Winnipeg on the completion of the Southeastern Railway to Rainy River.

The Canadian-American Glass Co., recently organized, will establish a large plant at Kingsville, Ont., and will absorb the R. M. Leggett Bottle & Glass Co., Detroit. The Detroit concern has a capacity of 90 tons per day.

Rolland Brothers, importers and manufacturers of cabinet hardware, upholstery goods, etc., Montreal, are about to remove to either Roxton Falls or Farnham, Que., each of which places has offered them a bonus of $20,000 to locate there.

H. E. Moffat, J. A. Bain, E. A. Brown, G. de C. O'Grady, and J. G. Wallace, Woodstock, Ont., have been granted an Ontario charter as the Moffat Feed-Water Heater and Purifier Company of Woodstock, Ltd.; capital, $40,000; chief place of business, Woodstock, Ont.

There are points still to be learned about belting, as all power users will admit. Some of these are stated in another column, in the advertisement of W. A. Fleming, Montreal, Canadian agent for Reddaway's Patent Camel Brand Belting, which as all know has been the subject of one of the most famous patent law suits in Great Britain.

The Economy Manufacturing Company of 613 Washington Life building, 141 Broadway, New York, has just completed the installation of a hydro-carbon gas fuel system at the plant of the B. Greening Wire Company, Ltd., Hamilton, Ont. This plant was equipped under the superintendence of H. Etches, M. Inst. Mech. Eng., 83 Front street west, Toronto.

C. C. Dodge, S. F. Roop, W. E. Roop, Oberlin A. Rogers, E. M. Barteaux, G. E. Hutchinson, E. S. Dodge, A. J. Morrison, J. H. Charlton, W. H. Chipman, A. E. Lawson, W. G Parsons, F. E. Cox, Middleton, N.S., and Thomas R. Jones, Nictaux, N.S., have applied for a charter as the Middleton Wood Working Co., Ltd.; chief place of business, Middleton, N.S.; capital, $10,000.

The Robb Engineering Co., of Amherst, N.S., received the following orders within a few days: Five boilers for fog horns from the Department of Marine and Fisheries, a 100 h.p. engine and boiler for the new electric station at Campbellton N.B., a 40 h.p. engine for the electrical plant of the St. John elevator, a 25 h.p engine for the Ogilvie Milling Co., Winnipeg, a 15 h.p. engine for S. Raworth, Port Elgin, N.B., and an 80 h.p. engine for Kilgour Shives, Campbellton, N.B.

The proprietors of Delahay's moulding foundry, Pembroke, Ont., placed a new man over their old foreman last month. The latter resented this and left his work, and the employees struck, to show that their sympathies were with the old foreman.

The new dynamite and powder factories for the Ottawa Powder Co., near Ottawa, are completed. There are seven frame buildings, including magazine, nitro-glycerine house, soda house, pulp house, packing house, root house and engine house.

H. Mooers, E. Mooers, A. B. Campbell, W. J. Doble, Kingston, Ont., and H. F. Mooers, Goderich, Ont., have applied for a Dominion charter as The Frontenac Milling Company, Ltd., to do general flour milling business throughout Canada; capital, $50,000.

According to the Woodstock, N.B., Despatch, there is a possibility of the old Upper Woodstock Iron Works being put into operation, after having been closed down for many years. In 1864 these works produced about 2,750 tons of iron, and employed 75 men.

Belleville, Ont., has passed the by-law relating to the Mitchell-Abbott Iron & Steel Company by a majority of nearly a thousand. The company is composed of Frank A. Mitchell, of Norwich, Conn., and William Abbott, of Montreal. The by-law gives the company free land, exemption from taxation and a bonus of $50,000, to establish rolling mills, etc., in Belleville.

The raising of large boulders in the St. John, N.B., harbor is being accomplished in an interesting manner. A boulder, which weighs many tons, had been slung by the diver with chains. The chains and ropes on the hoisting scows were easily broken in trying to lift the heavy rock. The boulder was again slung, and at low water two scows were brought into use with strong timbers across them. The hoisting gear was secured to the timbers and as the tide raised, the scows lifted the boulder, and at high water the large rock was placed out of the channel.

The Lancaster Machine Works, Lancaster, Ont., have placed on the market something new and good in a pumping engine for creameries and milk skimming stations, by means of which they can operate from one to five pumps. Several attempts have been made to get up an effective pump for this purpose, but it remained for this enterprising firm to surmount the difficulties met with in former makes and give to dairying a complete machine at a low cost. There is already a good demand for them, so the company informs us.

The steel grain storage plant of the Canadian Pacific Railway at Fort William, Ont., is now in operation. The capacity is 3,000,000 bushels, consisting of a series of steel tanks which are airtight, and being also fire-proof, no insurance is carried. The elevator building proper is built of structural steel, with one-quarter inch steel plate floors, supported on "I" beams, the steel frame being covered with heavy corrugated steel. It contains the scales, steel circular garners, steel elevator legs, power shovels, carpullers, warehouse, separators, steel spouting, transmission machinery, and fixture for the weighing and transferring of grain from cars to tanks, or direct to vessels. Two belt galleries run over the top of the tanks. They are built of steel, and contain two belt conveyors, each with trippers for distributing grain to various tanks, or direct to vessels. The shipping capacity is 40,000 bushels per hour. The unloading capacity is 400 cars per day. The boiler and engine-house is built of Lake Superior stone, with steel truss roof, and contains one 400 horse-power condensing engine; three boilers, 66 inches by 16 feet, with all the necessary pumps and fixtures. The power is transmitted from the engine to the steel house by a 400 horse-power rope drive. Tunnels constructed of stone under the tanks contain the belt conveyors for transferring grain from the tanks to the steel building, where the grain is weighed and shipped to vessels by means of the conveyors in the steel galleries over the tanks; dock spouts being attached to the end of the galleries for receiving the grain from the belt conveyors. There are 16 steel tanks, 58 feet in diameter, by 60 feet high, and 32 tanks 20 feet in diameter by 60 feet high. The tanks are ranged side by side, the smaller tanks in a double row, flanked on each side by a row of eight big tanks.

At the recent annual meeting the following officers were elected by the Architects' Association, province of Quebec: President, A. Raza; first vice-president, S. H. Capper; second vice-president, G. E. Tanguay; secretary, Joseph Venne; treasurer, N. E. Doran; auditors, A. Chausse and Heriot; counsellors, Peachy, A. T. Taylor, G. A. Monette and Archibald.

As we go to press we learn that the Canadian Motor Syndicate has completed negotiations for the purchase of a block of land in the central part of Toronto, on one of the main street car lines, and for the immediate erection of a building 40x60 feet. The syndicate is on the look-out for business in various lines, both in electrical and hydro-carbon departments.

W. German, M.L.A., Welland; James Battle, Thorold; W. Thompson, St. Catharines; George Dawson, St, Catharines, and Joseph Battle, Thorold, composed a deputation from Welland County, which recently waited on the Minister of Railways and Canals, seeking for increased water-power privileges on the Welland Canal. The subject is a difficult one for the Government, because while at certain seasons of the year power can be supplied from the canal without inconvenience, yet the complaints which always attend the necessary unwatering of the canal, are a source of considerable trouble to the Government.

The death of John W. Keeley closes the history of one of the most remarkable stories of the century. Mr. Keeley professed to have discovered a new motive power and to have invented a machine to utilize it. The motive power was the ether which permeates all space. He succeeded in convincing great capitalists that his claims were well-founded, and hundreds of thousands of dollars were supplied him for carrying on experiments. But his motor never worked successfully, and he has died without revealing whether he believed himself in some real discovery, or whether he was merely deceiving the public.

City Surveyor St. George, Montreal, and Engineer Janin, who has been given the contract for establishing a sewage farm in St. Denis Ward, Montreal, made recently a trip to a number of cities in the United States, where sewage farms are operated. These were carefully inspected and the result was highly satisfactory both to Mr. Janin and Mr. St. George. Both have stated that the St. Denis Ward establishment would be constructed so as not to be in the slightest degree a nuisance. At Brockton, Mass., the sewage farm skirts the main road and houses are built within a few feet. There is no smell at all from it, the engineers say. Its size is twenty-three acres, all of which are under cultivation. The population of Brockton is 33,000.

Approval has been given by the Ontario Board of Health to the plans of the proposed waterworks for the village of Stirling, Ont. The supply is to be taken from Oak Lake, about 300 feet above the village, and transported in iron pipes. The board feared that there might be danger of pollution to the water supply, but learning that the water was required mainly for fire protection, agreed to the plans subject to the understanding that changes should be made in the event of the proposed system proving dangerous to the public health. The Board has interdicted for the present the construction of a ditch between Welland and Port Colborne, whereby it was proposed to drain Humberstone marsh into the Welland canal. This action was taken on the complaint of Dr. Goodman, the Health Officer of St. Catharines, who pointed out that the proposed drainage scheme would result in the pollution of the Welland canal, from which the water supply of St. Catharines is derived.

FIRES OF THE MONTH.

Nov. 3rd. G.T.R. freight sheds and G.N.T. steamer "Pacific," Collingwood, Ont.; loss, $100,000.——Nov. 8th. Paul Bros'. planing mill, Midland, Ont.; loss, $5,500.——Nov. 11. Wellington, B.C., coal mining engine house, $15,000.——Nov. 12th. Pillow & Hersey bolt works, Montreal, loss covered by insurance.——Nov. 13th. Jos. Shearer's planing mill, Montreal, $10,000.——Nov. 26th. Stevens Manuacturing Co., London, Ont.; damage about $10,000.

—A. E. Payne, E.E., who has been employed by the Royal Electric Company for the past four years as a traveler, will in the future represent the Packard Electric Co., St. Catharines, and R. E. T. Pringle, Montreal.

Mining Matters.

Mica is being profitably worked in the vicinity of Kingston, Ont., this season.

R. Wood, Snow Road, Frontenac county, Ont., claims to have discovered there a vein of ore which contains nickel in paying quantities.

Thomas Byrne, P.L.S. has returned from Michipicoten, Ont., where he has made extensive surveys on behalf of the Ontario Government.

It is said that deposits of iron ore which may be used to produce speigel have been discovered in Cape Breton, and will be extensively worked.

A large flow of natural gas is reported from a well being drilled on Wm. Bellimer's farm at Ryckman's Corners, a few miles from Hamilton, Ont.

The Hall Mines Company, Nelson, B.C., is said to be arranging with the Kootenay Light and Power Co., for power to run the mine and the smelter.

R. H. Ahn is establishing a reduction works at Norman, Ont. The mill is intended to treat the ores of a number of properties in which he is interested.

Five hundred and twenty-nine dollars and twenty-five cents is the value of the first gold brick produced from 33 tons of ore from the Treasure mine, eight miles to the southeast of Rat Portage.

A School of Mines is being established in Rossland, B.C. The following have the matter in hand: E. Durant, J. Martin, W. A. Carlyle, C. O. Lalonde, S. Curtis, R. Adams, J. P. Hennessy and A. Cameron.

Another discovery, said to be of very rich gold quartz, has been made in the new district situated to the southeast of Rat Portage about seventy miles, known as the Sturgeon and Deer Lakes district.

A sample of galena from Great Slave lake was recently sent by J. A. McDougall to Dr. Dawson, director of the geological survey, for assay. The assay shows silver at the rate of 16 ounces to the ton.

A gas well has been discovered on the farm of A. Markham, Tilbury North. An artesian well was being bored for water, when a very large flow of gas was struck. It is proposed to pipe the gas to Chatham, Ont.

The Grand Calumet Mining Company has discovered a rich zinc mine near Rossport, in the Algoma district and intends opening it up at once. It will be worked all winter. The company has several mines at Calumet Island and has formed quite a settlement there, having erected cottages for the workmen, about sixty in number. The company has shipped 1,500 tons of ore during the past summer, principally to Antwerp, Belgium, the value of which was about $30,000.

The question as to the relative cost of hand or of machine drilling is contributed to by some data obtained by The Rossland, B.C., Miner from J. B. Hastings, the manager of the War Eagle Mining Co. Mr. Hastings keeps probably the most complete account of the expense of working that is to be found in the northwest: In estimating the cost of any work, he includes the cost of management, clerical work, interest, depreciation of the plant, legal fees, and in fact every item of expense which the mine undergoes. In this way his figures are useful for basing estimates upon the various outlays for mining development. It has been contended that hand work is actually cheaper than machine work, as less powder is required, while the expenses of fuel, plants and engines are not experienced. Mr. Hastings' figures show that for drifting by hand the total cost was $35 per foot, while with a machine under similar circumstances the total charges amounted to $17.50 per foot. In the item of underhand stoping, the difference in favor of machines was even greater, for there one stope was worked by hand at an expense of $7.50 per ton, while with a machine the total cost was only $2.50.

Senator Snowball, Chatham; F. P. Thompson, Fredericton, N.B.; J. L. Black, Sackville; Willard Kitchen, Fredericton, N.B., have purchased 57 per cent. of the Modstock Gold Mining Co., whose property is located at Forest Hill, Guysboro, N.S., for $22,800.

R. H. Gibson, Bradford, Pa., who has been exploring lands on Manitoulin Island since April last for petroleum, claims to have been very successful, and struck oil in four wells. He is now engaged in sinking a fifth. The oil was struck at 450 to 600 feet. In two of the wells natural gas and rock salt were struck.

The Le Roi passed into the possession of the British-American Corporation at a meeting in Spokane, Nov. 23rd, when J. C. Mackintosh was elected president, and other directors of the B.A.C. were also elected to office in the Le Roi Co.

Gold mining circles in Nova Scotia are much exercised over the rumored discovery again of the "Rose lead," so-called, in the Montague gold district near Halifax. It is said to have been traced over three properties and is wonderfully rich in gold.

Among the northern mines there are two sections more than any others that at present are looked to as possible rivals of the Klondyke, these being the Atlin Lake field at the northern extremity of British Columbia, and Thistle and Blueberry creeks, just south of the Stewart river. The discoveries at these latter diggings are more recent than the Atlin finds, and definite reports are only now commencing to make their appearance. One of the best of these is furnished by G. H. Bunn, an experienced miner and a member of the Scroggie party—discoverers of the creek of that name—who has come direct from the new scene of mining activity. He says: "Thistle creek is in my opinion one of the best and most promising gold streams of the whole north country. It is on the right side of the Yukon, and enters that river at a point about twenty miles above the Stewart, heading on the opposite side of the divide at a point from the west fork of Scroggie creek, only a few miles from that fork. The mouth of the creek is not visible from the Yukon, as it enters what is called a blind slough, and persons coming down the river do not notice it. The discovery on Thistle was made by a party of eight Scotchmen who had been prospecting in the neighborhood since last July."

The following return recently published in The Montreal Gazette shows the export of minerals from Newfoundland for the year ending June 30, 1898: Copper ore, 38,915 tons to the United Kingdom; copper ore, 17,801 tons to the United States; copper regulus, 9,616 tons to the United Kingdom; iron pyrites, 15,724 tons to the United States; manganese, 1,500 tons to the United States; arsenical pyrites, 125 tons to the United States; iron ore, 44,627 tons to different places. These figures show a steady advance in the mining industry and sufficiently indicate that the product of the mines is taking an important place among the exports of Newfoundland. In the current year (1898-99) there will be a very large increase in the export of iron ore, for which there is an unlimited demand in Great Britain. Before the end of this year there will be 100,000 tons shipped from the iron mine at Belle Isle—or more than double that of last year. The shipping of ore from the new iron mine at Bay de Verde will commence by May next. Shafts are now being sunk, and a railway, five miles in length, to the port of Old Pelican, is under construction, and the output is expected to be very large. A wealthy syndicate, says the correspondent, among whom are some of the great ironmasters of England, have leased this valuable mine, and will work it on a large scale. The vein is sixteen miles in length, and is estimated by experts to contain forty million tons of the finest quality, equal to that of Lake Superior. In the same peninsula, half a dozen more veins of iron ore have been discovered, and now await development. At Grote's Point, too, new discoveries are announced. In fact, the whole district around seems to be highly mineralized. It is evident that Newfoundland will take a high place among the iron-producing countries of the world. Then in copper, of which some ten million dollars' worth have been exported in the last thirty years, there are satisfactory advances. Tilt Cove, the oldest mine, is more active and more productive than ever. Little Bay, which was supposed to be exhausted, has lately taken a new departure, a new copper vein, nine feet in width, having been discovered, and is now worked by a London company. On the west coast, at York Harbor, Bay of Islands, there is also a discovery of copper which promises well.

Railway Matters.

A collision on the Grand Trunk Railway between Montreal and Toronto resulted in the death of 12 persons, Nov. 14th.

J. G. McIntyre, who for over 40 years has been a foreman boiler-maker with the G.T.R., and who for the past ten years has been employed at the Grand Trunk shops at Stratford, Ont., has been dismissed.

Application will be made for a charter for The Arthabaska Railroad Company to build a railway from Dudswell, on the Quebec Central Railway, in Wolfe county, to Maddington Falls, in Ste. Anne du Sault, on the Intercolonial Railway.

By the explosion of a locomotive boiler a terrible accident took place Nov. 10th, on the C.P.R. one mile east of Shuswap. Kamloops, B.C., two men lost their lives, and one was seriously injured. The dead are: E. Reid, brakesman; James Little, engineer. John George, the fireman, was badly scalded.

The Rutland & Canadian Railroad Bill has been passed by the Vermont Legislature. The bill passed incorporates the Rutland & Canadian Railroad Company, with a capital stock of $1,000,000, giving it the right to construct a road from Burlington to the Canadian line. The construction of this line will give the Vanderbilts a line from New York to Canada and the great lakes.

The Canadian Locomotive and Engine Works Company, Kingston, Ont., has received the contract to build six locomotives for the Canadian Pacific railway. They are to be compound engines, The largest passenger engine ever built in Canada has just been completed at these works, being the first of five being built for the Intercolonial. The driving wheels are 72 inches in diameter; the boilers are designed to carry a pressure of 180 lbs. to the square inch; the water tank will hold 3,000 gallons and the tender nine tons of coal. The engine weighs 70 tons, and the tender 44 tons, a total of 114 tons. It is fitted with the latest improvements.

A change was made about the 1st November in the management of the G.T.R. locomotive shops in Stratford, over which J. Davis Barnett has presided for so many years, first as assistant superintendent, and latterly, under the terminology of the new management, as master mechanic. Mr. Barnett has resigned, and he handed over his responsibilities to J. McGrath, the foreman of the erecting shop, who now has charge, under the designation of general foreman. The position of master mechanic at Stratford is abolished. The new general foreman is quite a young man, and was born in Toronto. He entered the old Northern railway shop in 1882, and gradually rose to be foreman of the Toronto locomotive repair shops, whence he was sent to Stratford about six months ago to become foreman of the erecting shop there, in succession to A. A. Maver, who was transferred to London.

The Department of Militia, as soon as the necessary arrangements can be effected, will commence the erection of a new building for militia stores at Ottawa. It will be located on the tennis grounds in the rear of the drill hall and will be a four story brick building with adequate accommodation for the storage of the militia supplies for the Dominion. It is expected that the structure will be begun in a short time and completed early in the spring, and this being the case the present quarters at the canal basin will be vacated. When this is done J. R. Booth states that work will be commenced on the new Ottawa Union station. As before stated, the location will be on the site of the present depot and will extend to the bridge. The big building will contain the offices of the railway companies using it, each of which will be on an equal footing and furnish their proportionate cost of its maintenance.

The Central Ontario Railway is to build a spur from Ormsby to Bancroft, Ont.

Trains have begun running into Pembroke over the Pembroke Southern Railway.

Application is being made for a British Columbia charter for a railway from Kamloops Lake to Atlin Lake.

The C.P.R. has arranged to make extensive improvements at Laggan, B.C., including the erection of a stone five stall round house.

The Lake Manitoba Railway & Canal Company has decided to complete another 25 miles of the Swan River extension at once.

Wm. Strachan, president of the Midland, N.S., Railway, and Peter Lyall, one of the directors, recently made an inspection trip over the road.

The necessary money for the charter, surveys and other preliminary expenses for the Thunder Bay & Nepigon Railway has been subscribed in Port Arthur, Ont.

The Ottawa & Parry Sound Railway during the season of navigation just closed, carried twelve million bushels of grain and 100,000 tons of flour and pork from Parry Sound through Ottawa.

Large seizures have been made by the Customs Department of the Dominion involving eighteen locomotives and one thousand box cars, belonging to the Booth system of railways, with headquarters in Ottawa, Ont.

A report is current in Vancouver, B.C., that the Great Northern Railway will bridge the Fraser River at New Westminster and run a line into Vancouver, connecting with the Westminster Southern Railway, part of the Great Northern system. This new line will give the Grand Trunk Railway an entrance into Vancouver via its Chicago connections.

Application will be made at the next session of the Dominion Parliament, for an act to incorporate a company to construct a railway from Dawson, along the Klondyke river to the confluence of Hunker Creek, along Hunker Creek to Indian River, and along its course to its junction with the Yukon River, thence along the Yukon River to Dawson, with power to construct and operate a branch up Bonanza and El Dorado Creeks to Dominion Creek.

General Manager Whyte, of the C.P.R., took over the Crow's Nest Pass railway, on behalf of the C.P.R., on November 15 from Contractor Haney. The town of Fernie, B.C., is now a lively place. The 150 miners who arrived with their families from Halifax are now all at work. Seventy-five coke ovens have been built. In all there are to be about 200 ovens, which will turn out an average of 1¼ to 1½ tons per day each. This coke will be sent to the Nelson and Pilot Bay smelters. The coal at Michael creek, which is now being opened out, not far from Fernie, will produce as much coke per ton as the Fernie coal, says General Manager Whyte, and of much better quality for domestic use.

L. A. Hamilton, C.P.R. land commissioner, who has returned to Winnipeg accompanied by T. W. Tye, chief engineer of the Robson-Penticton branch which is being extended into the Boundary country, stated that while in Montreal they had located the principal townsites along the road. They will be Gladstone, Cascade, Grand Forks and Greenwood, and arrangements have been completed whereby the company has become interested in the development of the towns. Grand Forks is located at the point where the north fork of Kettle river flows into the main stream. Gladstone, which is situated 24 miles from Brooklyn, will be the distributing point for the Burnt basin and Christina lake. Cascade is situated on the international boundary at the foot of Christina lake, and is well supplied with water power for manufacturing and other purposes. Greenwood will be the principal mining point in the Boundary and it is surrounded on every side by developed mines, which are expected to start shipping ore to the company's smelter at Trail as soon as railroad facilities are provided.

Electric Flashes.

It is stated in Montreal that the Royal Electric Co. and the Montreal Gas Co. are to be amalgamated.

The Davidson Mnfg. Co., Montreal, has purchased a 30 h.p. induction motor from the Canadian General Electric Co.

The Canadian General Electric Co. are installing a 100 light electric plant for the Guelph Carpet Co., Guelph, Ont.

C. O. Beauchemin, Montreal, has purchased from the Canadian General Electric Co. a 30 k.w. generator of the multi-polar type.

The Canadian General Electric Co. is installing an electric plant of 100 lights capacity for the Williams Shoe Co., Brampton, Ont.

The North Hatley, Que., Electric Light Company is erecting its poles and putting on the wire, and will soon be in a position to furnish light.

Duncan & McLennan, who have the lighting contract for Campbellton, N.B., state that they will have the lights turned on by December 24th.

The Mispec Pulp Mills, St. John, N.B., are installing an electric lighting plant, and have purchased a 400 light dynamo from the Canadian General Electric Co.

The municipal council of Galt, Ont., and the Galt Gas Company have agreed upon the sum of $67,750 for the gas and electric light plants, which the company is willing to accept.

O. & W. McVean, Dresden, Ont., are installing an electric lighting plant for use throughout their various mills. The Canadian General Electric Co. is furnishing all the apparatus and wiring supplies.

The Canadian General Electric Co. has recently closed a contract with Geo. Matthews Co., Peterboro, for the installation of an electric lighting plant. The dynamo is to have a capacity of 150 lights.

The Toronto Electric Light Co. has placed an order with the Canadian General Electric Co. for a large power generator of the latest multi-polar type. This machine is to be wound to deliver current at 250 volts pressure, and has a capacity of 600 h.p.

The Ottawa Electric Co., Ottawa, Ont., is increasing the arc lighting capacity of its power station, and has placed an order with the Canadian General Electric Co. for two two-circuit automatic regulating "brush" arc dynamos, having a capacity for 125 arc lamps.

Dr. C. J. Edgar, manager of the Eastern Townships Light, Power and Carbide Company, has concluded the purchase of the water power at Nangle's Dam, near Rock Forest, Que. The company intends to transmit power for lighting and power purposes to Sherbrooke, Que.

Cornell Bros., Stanbridge East, Que., are installing an electric lighting plant, and have purchased for their requirements, from the Canadian General Electric Co., a 400 light dynamo of the latest multi-polar type, together with marble panel switchboard and wiring supplies.

The order for a 100 h.p. engine and boiler for the Campbellton, N.B., electric light plant, has been given to the Robb Engineering Co., Amherst, N.S., and for the electrical apparatus to the Royal Electric Co. Duncan & McLennan have the contract, and state that the lights will be lighted Dec. 24th.

The Lieutenant-Governor-in-Council, on the advice of the Attorney-General of Ontario, has referred to the High Court of Justice certain questions to determine whether the non-completion by the Niagara Power Company of the water connections to the extent of 20,000 horse-power, and 10,000 horse-power, actually ready for use, supply, and transmission by 1st Nov., 1898, has not put an end to the agreement between the Park Commissioners and the said power company, giving to the latter the exclusive use of the water-power at Niagara Falls.

The Little Salmon River Telephone Co. has acquired the right to carry its wires into St. John, N.B.

The capital stock of the Northern Electric and Manufacturing Co., Ltd., has been increased from $50,000 to $1,000,000.

A new copper telegraph wire is being strung over the Crow's Nest Pass railway, similar to the one between Montreal and Vancouver. It is also intended to string one into the Boundary Creek district as soon as the line can be built with safety along the Robson-Midway extension.

The municipality of Barrie, Ont., is conferring with the Barrie Electric Light Company regarding the purchase of the latter's plant. The town has placed $35,000 in the council's hands to be spent on a municipal plant, and the question now is whether the existing plant will be purchased or an entirely new plant installed.

Ancaster, Ont., township council has passed a by-law to extend the Hamilton, Chedoke & Ancaster Electric Railway Company's right of way on the highway for another term. The council also passed a by-law extending the time in which the company is to earn the township bonus of $5,000 from December, 1898, to December, 1899.

Notice is given that the Canadian Power Company will apply to Parliament at its next session, for an act to extend the time for the completion of its works, to extend the bonding powers of the company and to more particularly define its powers, and to change its name.

The city council of St. John, N.B., has offered to settle with the street railway, Sir Wm. Van Horne, and James Ross, Montreal, on a basis of five hundred thousand dollars valuation for taxation purposes. The offer is made to cover taxes due from 1895 to 1898, and to avoid litigation. The balance claimed by the city is thus reduced to about $19,500.

The Perth Waterworks Company has completed arrangements for the removal of the engine and boiler, formerly owned by the Tay Electric Light Company. This is a move which the company has adopted to assure constant power to its customers, as in the event of any disarrangement of the water power it would be impossible to supply light. Now steam will be used as an auxiliary power, and a more complete service is anticipated.

In re The Bell Telephone Company and the City of Hamilton, it was decided by the judge that in assessing, for purpose of taxation, the poles, wires, conduits and cables of the telephone company, the cost of construction, or the value as part of the concern, is not the test; they must be valued, in the assessment division in which they happen to be, just as materials which, if sold or taken in payment of a just debt from a solvent debtor, would have to be removed and taken away by the purchaser or creditor.

Thompson vs. The Brantford Electric and Operating Company., Ltd., was an action in which the defendants, by resolution of the Board of Directors, authorized their manager to purchase from the plaintiff, on certain terms of credit, a machine necessary for the carrying on of the defendants' business. The defendants' manager bought the machine, but on different terms, the plaintiff having no knowledge of the board's resolution; and the defendants received and used the machine. It was held, that the purchase was within the scope of the manager's authority, and that the defendants were liable for the price of the machine.

An accident occurred early last month to the dam which was being constructed at St. Gabriel over the Jacques Cartier river for the Canadian Electric Light and Power Company. The heavy rains had greatly swollen the stream, and caused it to overflow its banks, and large quantities of brushwood had also been brought down, and their pressure, combined with the weight of water backed up by the nearly finished work, proved too much for the dam, which gave way suddenly, and was carried down over the rapids. The men and horses working on the dam had barely time to get out of the way of the flood. The loss to the contractors, Ross & Barry, will be at least $2,000. The accident, however, did not cause any suspension in the operations, which were carried on as usual.

The Stouffville Electric Light Co. is making changes in its electric lighting station, among them being a new dynamo with a capacity of 500 lights. It is putting in an S.K.C. two-phase machine from the works of the Royal Electric Company, so that it can supply power as well as light.

The town of Campbelltown, N.B., is installing a civic electric lighting plant. It is putting in Robb-Armstrong high speed engines with Monarch boilers, and one 60 k.w. S.K.C. two-phase dynamo with the full capacity of the machine in transformers. They intend to use this S.K.C. machine for the supplying of arc lamps for the streets as well as incandescent light for interior lighting and for power in the daytime.

The lighting plant of the Stouffville Electric Light Company, which was installed about five years ago, suffered damage a short time ago by the armature bands breaking and wrecking the machine. In replacing this dynamo, there has been installed an S.K.C. inductor type machine, and it will do away with the possibility of having another wrecked armature, or a burnout, or troubles from brushes and commutators.

Acton, Ont., has decided in favor of a municipal electric plant, and municipal ownership of the lighting system is being actively canvassed in Pembroke, Ont., with a probability of being adopted. The Brockville town council has not yet decided in favor of municipal ownership, but if every elector in the town would persistently ask the councillors why it is that gas costs $2.50 per thousand cubic feet in Brockville and only 90 cents in Toronto it would not take them long to come to a decision in the matter.—Brockville, Ont., Times.

The dynamos at the Brockville, Ont., electric light station were stopped at night during the storm of November 17th and 18th on account of the inability to procure sufficient water for the boilers in the engine room. This was caused by the severe eastern gale lowering the water below the intake pipe which is lowered eight feet below the surface of the water. The lights were not started again until the wind lowered and the water resumed its level sufficiently to cover the intake pipe. The lights were out for several hours.—Brockville, Ont., Times.

For some time past Lindsay, Ont., has been trying to secure a cheap electric power. Culverwell & White-Fraser of Toronto undertook to form a company and transmit the power from Fenelon Falls to Lindsay, but were unable to make the financial arrangements necessary to the undertaking. The matter has been taken up by some of the citizens with A. E. Ames of Toronto. An electrical expert is to be employed to look into the matter, and if it is endorsed by him and a certain amount of stock taken by the citizens, Mr. Ames will, it is said, undertake to secure the necessary capital to carry the scheme through.

The Welland Vale Manufacturing Company of St. Catharines has increased its factory buildings, and is making a change in the lighting plant. It has, heretofore, operated a direct current two-wire system, but has decided to keep pace with the times, and is installing a 600 light alternating current two-phase S.K.C. plant, which will operate on the three-wire system, giving them a much cheaper distribution, as well as the benefit of having an inductor type dynamo, which they are satisfied possesses a great many advantages over those of the old type. They are following in the lines of the Penman Mnfg Co., of Paris, and the Cockshutt Plow Co., of Brantford, which have replaced their direct current incandescent plant by inductor type machinery.

The proposal of the directors to increase the capital stock of the Royal Electric Company from $1,500,000 to $1,750,000 by the issuance of 2,500 shares of the nominal value of $100 each, to be offered to the shareholders; and also to effect loans by the issuance of mortgage or hypothecary bonds or debentures to an amount not exceeding in the aggregate, including all bonds at present outstanding, 75 per cent. of the paid-up capital stock, and to bear a rate of interest not exceeding 4 per cent. per annum, was not favorably entertained by the shareholders, of whom the majority seemed to favor the raising of all needed funds by allotting additional stock instead of adding to the bonded debt of the company. It was decided to increase the holding of the Royal Electric Co. in the Chambly Manufacturing Company from $200,000 to $300,000.

The report of Percy Domville, the expert electrician engaged to prepare an estimate of the cost of a civic lighting plant for Hamilton, Ont., has been submitted to the city council. The substance of the report is favorable to the position of those who favor the installation of a civic electric light plant. At present Hamilton pays 25 cents a night, or $91.25 a year, for each arc light. Mr. Domville estimates that with a civic plant it would cost the city only 14.93 cents a night, or $54.55 a year for each arc light. This estimate includes interest on investment and a liberal allowance for depreciation of plant, and Mr. Domville says his estimate is too high rather than too low. Accordingly it would pay Hamilton to do its own street lighting. The difference between the price paid and the estimated cost of production is about $15,000 a year.

James Ross, vice-president of the Montreal Street Railway Company, who has recently returned from an extended visit to Great Britain, made some interesting remarks upon street railways in Britain and other matters, in the course of an interview with The Montreal Gazette. Mr. Ross observed that while he did not wish to cast any reflections upon the municipal bodies of Great Britain as regards the slow manner in which they moved, yet it was a fact that most of the cities were extremely conservative in the matter of a change from horse or steam to electrical power. The overhead system appeared to be generally accepted, and Liverpool and Glasgow, which had purchased their respective street railway systems, had each from two to three miles in operation. Bristol and Dublin were also to have the trolley. In Birmingham the people were undecided what course to pursue, and they will, Mr. Ross added, probably await results in the other cities. Mr. Ross also stated that all lines of business in Great Britain seemed to be prosperous.

The McGill Applied Science Technical Society listened recently to a paper, written by R. M. Wilson, science, '99, which was a report upon the testing of the electrical generating plant, put in by the Royal Electric Company at Chambly. The river at Chambly has been harnessed and by means of the machinery described by Mr. Wilson will soon send over heavy copper wires, energy equivalent to 11,000 horse-power in the form of high pressure electricity. The transforming of the power of the water into electric current is effected by four generators, and in the testing of these generators Mr. Wilson was engaged. The electrical equipment at present consists of four two-phase generators of 2,000 k.w. capacity each, two 140 k.w. exciters and necessary high and low tension switchboards for same, with wiring. The main part of the paper was taken up with a relation of the methods of testing the machines. So rapid are the strides made in electrical advancement that scarcely two plants are built in the same way, and thus in the setting up of each plant there is a great deal of interest attached to the testing of the machines, the tests showing the results of the new ideas involved.

Marine News.

The steamer "Edna Brydges" ran on a reef and sank on her last trip from Rat Portage to Fort Francis, Ont.

The Montreal Harbor Commissioners have bought a tug from Carrier, Laine & Co., Levis, Que., for $20,482.

The steamer "NorthernBelle" was burned Nov. 7th, about two miles up Byng Inlet, Ont. The cause of fire is unknown.

Kivas Tully, harbor engineer, and C. H. Rust, city engineer, Toronto, have prepared plans for extensive harbor improvements.

J. & A. Allan are building two new steamers, each of which is to be fitted to carry a large quantity of produce in cold chambers, for the cooling of which J. & E. Hall, Dartford, England, are supplying the machinery.

The new steamer "Toronto," of the Richelieu and Ontario Navigation Company's fleet, has been given its trial trip last month. The boat was out three hours, and was in charge of Captain William Boyd, and everything ran smoothly both in the machinery and general management. The chief engineer is W. A. Black. Among those present were J. Kerr Osborne of the Richelieu Company; George H. Bertram, M.P., president of the Bertram Company; John Bertram, vice-president; A. Angstrom, manager.

We are informed that J. & E. Hall, Ltd., have no less than seventy refrigerating machines to be fitted on board ship at the present time, which comprise machines for the British Admiralty and foreign Governments, the White Star Line, Hamburg-American Steam Packet Company, and many others of the most important steamship companies.

The new Government steamer now being built at Dundee, Scotland, for service between Prince Edward Island and the mainland, to replace the "Stanley," will cost $185,000. Its tonnage is about 1,200 with 2,900 horse-power. It will be provided with a strong protected stern for breaking ice, and its rudder will also be protected by a stee ice cutter.

Lieut.-Col. Anderson, chief engineer of the Dominion Department of Marine and Fisheries, has reported the result of his examination of the ship channel between Montreal and Quebec, in which a number of steamers have recently grounded. He says the opinion is freely expressed that a good deal of the trouble in the navigation of the river arose from the ignorance of some of the pilots.

The importation of beef to England from America is still on the increase. Two fine steamers building for the Atlantic Transport Company by Messrs. Harland & Wolff are to be equipped with a complete installation of refrigeration on J. and E. Hall's Carbonic Anhydride System, the machine being situated in the main engine room in both cases, which arrangement reduces the staff as compared with a separate engine room necessitated by some systems.

J. B. Coyle, manager of the International Steamship Co., died at his residence in Portland, Maine, recently, after a protracted illness. Mr. Coyle had been associated with the steamship business for many years, and was a long time chief engineer of the International Line, but became president and manager of the company about ten years ago. Some time ago he resigned the presidency but retained the position of manager. He had been manager of the Portland Steam Packet Company and the Maine Steamship Company.

By the contract between the Dominion Government and the Allan Line and Dominion Steamship Lines for the winter service between St. John and Liverpool, the first boat left Liverpool on the 12th ult. The first sailed from St. John on the 30th. For the first five weeks the sailings will be weekly from Liverpool on each Saturday. After that they will be on Thursdays. From this side, the sailing will on Wednesdays, unless other arrangements are made later on. The boats to be employed are the "Parisian," "Numidian," "Californian," "Labrador," "Vancouver" and "Scotsman."

Property owners along the river front at Amherstburg, Ont., are clashing with the United States Government over the lime kiln crossing dredging operations. Dredges have been for some time at work widening the channel by blasting and dredging from the Canadian bank. Heretofore the work has been going on above Amherstburg. Recently, however, a dredge under Captain Rooney, began work directly opposite the town. The property owners along the bank of the river immediately served notice on the captain to cease the work. They claimed that under the Crown patents the title of property extends to the bank of the channel. Therefore, in blasting away the bank they argue that the United States is stealing their property. Captain Rooney paid no attention to the protest.

It has been announced that one of the principal steamship lines running to the St. Lawrence is prepared to establish its terminus at Quebec on the basis of an exemption from all harbor dues for a term of five years. This information has been conveyed by a letter from the Hon. P. Garneau, president of the Great Northern Railway, to the chairman of the Quebec Harbor Commission, which states that the company in question is ready to negotiate with Quebec whenever it is prepared to close a contract on those terms, and to run a regular line of steamers between Quebec and Liverpool, loading the freight brought over the Great Northern and Parry Sound Railways to Quebec.

Work is progressing very satisfactorily on W. Davis & Sons' contract on the St. Lawrence Canal at Cardinal. It is the largest cut for the area of any canal on the continent, there being almost two million yards of excavation. The length from the point where it leaves the old canal below the town to where it re-enters above is one and one-third miles. There are four steam shovels, nine locomotives, a large number of horses and from six to seven hundred men employed. The contractors operate about fifteen miles of tracks and are dumping the earth two and one-half miles below the cut. The locomotives are averaging about twenty-eight trips every twenty-four hours and the Starch Works Company supply electric light from end to end, so that the work of excavation goes on all night.

Personal.

Henry Weston, Montreal, has been appointed managing foreman of the C.P.R. workshops at Perth, Ont.

G. Whittaker, Toronto, has been appointed second assistant superintendent of the street railway, London, Ont.

F. A. Wunder, New York manager of the Fort Wayne Electric Corporation, of Fort Wayne, Ind., was in Toronto recently.

Newton J. Kerr, an assistant in the city engineer's office, Toronto, has accepted the position of assistant city engineer, Ottawa.

Jno. Milne, head of the stove manufacturing firm of Burrow, Stewart & Milne, Hamilton, Ont., fell and broke his leg last month while walking home from his office.

John Kerr, the motorman on the Toronto Railway who was injured in a collision last summer, is suing the Street Railway Company for $7,500.

Sir John Fowler, who was engineer-in-chief of the Forth bridge, for which services he was a created a baronet in 1890, is dead. He was born in 1817.

C. G. Rothwell, assistant last session to Professor De Kalb, Kingston, Ont., School of Mining, has been appointed assistant manager of El Concheno mine, Chihuahua, Mexico.

R. S. Logan, Montreal, assistant to Chas. M. Hays, general manager of the Grand Trunk Railway System, was married at St. Louis, Mo., last month, to Miss Annie Rankin.

F. W. Dawson, engineer for the Indian Government at Bombay, has been in Canada recently looking over the Canadian system of canals for the information of his Government.

The employees of the New Vancouver Coal Co., Nanaimo, B.C., recently gave a dinner to Thos. Morgan, the new coal mines inspector for British Columbia. Wm. McGregor, superintendent of the mine, was in the chair.

R. G. McConnell, of the Geological Survey, has returned to Ottawa from the Klondyke and left for the East. He traveled a good portion of the Yukon and will make an extended report to the Department of the Interior.

Wm. Findlater, of the firm of Bannerman & Findlater, Elgin st., Ottawa, Ont., died a short time ago, after a brief illness. Deceased was 37 years of age, and was a cousin to the hero of Dargai Ridge. He leaves three orphan children.

Hartley Gisborne, M. Can. Soc. C.E., electrical engineer, formerly of Toronto, now of Winnipeg, has been appointed by the council of the Institution of Electrical Engineers, London, England, their local hon. secretary and treasurer for Canada.

The wedding of Collingwood Schreiber, Deputy Minister of Railways and Canals, to Miss Gwynne, daughter of Judge Gwynne, of the Supreme Court, took place November 14th at Grace Church, Ottawa. The wedding was private, only near relatives being invited.

We regret to announce the death of Matthew Cooper, foreman of the Canadian General Electric Company, which occurred at Peterboro recently. Mr. Cooper was for some years foreman of the Edison Electrical Works, Hamilton. He leaves a widow and six children.

Dr. S. A. Mitchell, son of John C. Mitchell, contractor, Kingston, Ont., has been appointed research assistant at the Yerkes Observatory in connection with Chicago University. He is a graduate of Queen's University, Kingston, with the degree of M.A. He also has the degree of Ph.D. from Johns Hopkins University, Baltimore.

Robert Hobson, secretary of the Hamilton Blast Furnace Company, met with a painful accident a short time ago. He had ridden up on a coke train from the smelting works to the Radial line, intending to take a car to the city. As he started to jump from the coke car one foot caught in the ledge and he fell to the ground, breaking his leg just below the knee. He was brought to the city on a Radial car and removed to his home.

W. S. Buckland, Montreal, has received the pleasing information that his son, who had served some time in the C.P.R. shops in Montreal, had, while in England, passed his examination for the Royal Navy, and received the appointment of engine-room artificer, which makes him a first-class petty officer. He had to compete against Old Country boys, and it speaks well for Canadian training when it is known that he took seventy-five per cent. of the marks.

F. S. Rathbun, one of the active partners and treasurer of the Rathbun Company, Deseronto, died suddenly while dressing on the morning of Nov. 26th. He appeared in the best of health and spirits on going to bed the night before at his usual time, and got up at his usual time, and went into his dressing-room, where, without any warning, he suddenly expired. He had lived all his life at Deseronto, and had taken a deep interest in, and done much to advance the commercial prosperity of the town. The news will be received with deep regret among his wide circle of friends, by whom he was very much liked and appreciated. Besides his active participation in the work of the Rathbun Company, he had interested himself in many of the commercial enterprises, railway and steamboat connections that have contributed to make Deseronto what it is.

The Kilmarnock Standard (Scotland), on the occasion of the laying of the foundation of stone of The Dick Institute, Public Library and Museum, presented to his native town by James Dick, at a cost of £11,000, refers in an interesting column of "personal notes" to the great success which attended all business enterprises in which the Dick brothers engaged; commencing with the adoption of gutta percha in the manufacture of boots, which for thirty years was their staple manufacture. Then, in 1870 they began to consider the capabilities of balata, a species of India rubber for strengthening cotton for belts, which became immediately successful for all kinds of machinery. Twelve years ago, on the occasion of his marriage, James Dick presented to the people of Glasgow the Cathkin Park, a gift that cost about £50,000. While on his bridal tour, which included a visit to Melbourne, Australia, the discovery of the Broken Hill Silver mine was brought to his notice, and he bought a seventh share of the whole mine, and sailed away. While he was on the sea his seventh share became a fortune. On his return, his brother Robert having died while he was away, he had to assume the proprietorship and management of the Greenhead works. Unexpected success attended him. The balata belts were found to be the best for machinery, especially in the deep shafts of gold mines in Johannesburg and other places. On one of his many journeys he secured a large interest in the Mount Morgan mine, which in itself would make him one of the wealthiest men in Scotland.

LITERARY NOTES.

We have received the annual reports of the city engineers of St. Louis, Mo.; St. John, N.B., and Toronto, Ont., whose contents are referred to in other parts of this issue.

The well-known "Hawkins'" books for engineers, firemen, electricians, superintendents and all steam users, are attracting a great deal of favorable notice from the reading public.

The Aikenhead Hardware Co., 6 Adelaide street east, Toronto, has issued a pamphlet describing the Pasteur Filter, under the title, Drinkable Water and its Hygienic Value in Health and Epidemic Diseases.

We are in receipt of a catalogue of the Standard Tool Co., Cleveland, U.S., which manufactures electrically welded bicycle parts, etc., which gives some interesting information about this line of the company's output.

The Scientific American Hand Book on Patents, Caveats, Designs and Trade Marks, published by Munn & Co., New York, contains valuable and useful information for the inventor who intends to protect in the United States the product of his genius.

The National Association of Master Plumbers, Gas, Steam and Hot Water Fitters, of Canada, has begun the publication of a monthly magazine, "The Official Bulletin," whose first number appeared last month. We take pleasure in welcoming the new journal to our table.

"Steam" is a handsome cloth bound volume of 130 pages, of which every one contains something an engineer wants to know. It may be had free by sending your address to the Babcock & Wilcox Co., 202 St. James street, Montreal. The illustrations are very numerous and show many of the finest and most famous buildings on the continent.

The proceedings of The Association of the Ontario Land Surveyors at its sixth annual meeting since incorporation have just been issued. The meeting was held Feb. 22nd and March 8th, 9th and 10th, 1898 and was well attended by the members as was reported in The Canadian Engineer for April. The report makes a volume of over 258 pages. The seventh meeting of The Association of Ontario Land Surveyors will be held in Toronto, beginning February 28th, 1899.

The Tidal Survey Branch of the Department of Marine and Fisheries of the Dominion of Canada has issued the Tidal Tables for Halifax, Quebec and St. John, N.B., for the year 1899, with tidal differences for the Atlantic coast of Nova Scotia, and for the St. Lawrence River, from Three Rivers to Gaspe. The tables are reprinted from Greenwood's Nautical Almanac and Tide Tables for 1899.

The eleventh edition of Lovell's Business Directory of Montreal has been prepared with the care and completeness which characterizes the works of reference issued by this well known firm. The present edition comprises a classified business directory with a general index to the classification, a guide to the streets of the city, and a large body of miscellaneous information, including the customs tariff.

The Year Book of Canada for 1897 has been issued from the Department of Agriculture, Ottawa, and contains the usual mass of statistics relating to every department of trade, commerce, finance, etc., of the Dominion. The compiler, Geo. Johnson, F.R.S.S., now ranks among the highest statistical authorities of the British Empire, and the present volume sustains his well-earned reputation.

The "Practical Engineer" Pocket Book, 1899, is a neat, strongly bound volume of convenient size; leather with gilt edges. There are over 400 pages of valuable matter clearly expressed and brought into small compass. There is a combined memorandum book and calendar included in the volume which is a most convenient feature. The "Practical Engineer" Pocket Book, the Technical Publishing Co., Ltd., Manchester, England.

We have received "Sewerage and Sewage Disposal," by Henry Robinson, M. Inst. C.E., Fellow of Kings' College, London; Professor of Civil Engineering, King's College, London, etc., etc., which is a very substantial volume of about 200 pages, published by E. & F. N. Spon, 125 Strand, London. The tabulated statistics are very valuable and comprehensive. The American trap system is unsparingly condemned on page 16. Though the American system is not explicitly mentioned; the advocacy of the free ventilation system described in The Canadian Engineer is very strong.

It was in the year 1847 that the first issue of the Canadian Almanac was published, and every year since it has made its appearance. Among the contents of the book which are especially valuable are: The Customs Tariff, Postoffice Guide, and Directories of various persons and officials, all of which are brought up to date, while the articles on the British Army and Navy and Forms of Government throughout the world are interesting and reliable. A feature that appeals particularly to all who are interested in the current history of the world is the Historical Diary, which is carefully prepared each year, and gives an excellent resume of the year's history. The publishers are to be congratulated upon the appearance of the 52nd issue of the Canadian Almanac. Price, 25 cents. The Copp, Clark Co., Limited, Toronto.

"Steam Navigation and its Relation to the Commerce of Canada and the United States," is the title of a very interesting volume by James Croil, of Montreal, published by William Briggs, Toronto, and produced with the usual typographical excellence of books issued by the Methodist Book Room. Mr. Croil is already known by his "Dundas; a Sketch of Canadian History," published a good many years ago, and now out of print. The present volume is the result of much painstaking labor, and traces the history of steam navigation from the beginning down to the past year or two. Most of our readers already know that the first vessel to cross the Atlantic entirely by steam was one of Canadian design and workmanship, namely, the Royal William. This vessel, by the way, was not only the first commercial steamship, but became the first steam man-of-war, as after being for some years in the Anglo-American trade, she was sold to the Spanish Government, and then to the Portuguese Government, who had her converted into a gun boat, propelled by steam. The author gives a very full account of the Royal William, whose achievements were considered worthy of the following tablet in the Canadian House of Commons: "In honor of the men by whose enterprise, courage and skill, the Royal William, the first vessel to cross the Atlantic by steam power, was wholly constructed in Canada, and navigated to England in 1833." Mr. Croil refers to the fact that the Molsons, who were prominent in the first development of steam navigation on the St. Lawrence, failed to get a monopoly of steam traffic in Lower Canada as Fulton had done in New York. It may be interesting here to recall the fact, not generally known, that Louis Papineau, the agitator, was among those who voted for this monopoly. The record of navigation on the Upper Lakes is rather deficient, but when allowance is made for this, the work is a most valuable history of steam navigation in Canada, while a good deal of general historical matter on the development of steam navigation throughout the world is brought under the reader's view. The volume contains 381 pages and about 100 illustrations.

The Rev. Chas. M. Sheldon's books, now so universally read, make it plain that that writer's hopes of the regeneration of the world lie in getting individuals more and more to do their daily tasks on Christian principles no matter what the sacrifice involved. In the best known of his books, "In His Steps," he clearly looks to the newspaper, carried on upon Christian principles, as largely the hope of the "coming kingdom." In looking about him for a newspaper upon his model, he seems to have hit on The Montreal Witness, to which he has addressed a letter, part of which we quote: "I have read The Witness with much interest. I cannot say that I know of any other daily paper in the United States that is conducted on such high Christian principles. I wish I did, for if ever we needed such a paper in our country we need it now. Let me express to you my appreciation of the Christian heroism and consideration which make a paper like The Witness a possibility. I have always believed it possible for a Christian daily to succeed. You have proved that it can. So much of the ideal newspaper in 'In His Steps,' is therefore real. I pray that you may continue to be blessed in your work. I do not know a more glorious opportunity for building up the kingdom on earth than by means of Christian journalism. I take the greatest pleasure in sending the copies of The Witness to newspaper friends of mine for their inspection. Charles M. Sheldon."

—Of nails, the imports into Japan from the United States increased from 3,260,858 katties in the first half of last year, to 7,494,197 katties in the first half of the present year—the katty being about 1.3 pounds; the total importations of nails had fallen meanwhile from 10,394,717 katties in the first half of last year to 8,754,035 in the first half of the present year.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trades from Great Britain during October and the ten months ending October, 1897, 1898 :—

	Month of October.		Ten months ending October.	
	1897.	1898.	1897.	1898.
Hardware	£7,921	£2,039	£58,593	£22,042
Cutlery	..	5,163	..	45,414
Pig iron	1,187	1,474	6,435	9,879
Bar, etc.	306	1,856	7,878	10,156
Railroad	6,885	..	45,778	25,154
Hoops, sheets, etc.	15,307	7,571	71,261	52,382
Galvanized sheets	13,439	11,034	49,986	55,286
Tin plates	30,122	19,843	162 971	123,882
Cast, wrought, etc., iron	2,932	4,196	28,889	28,653
Old (for re-manufacture)	1,292	..	6,483	3,574
Steel	6,440	3,696	47,501	43,430
Lead	4,888	7,360	23,950	32,025
Tin, unwrought	1,169	1,727	14,982	15,407
Alkali	8,767	10,440	34,849	42,475
Cement	2,880	5,835	18,491	23,762

—The Knowles, Ham & Nott Company are about to make extensive additions to their spring bed factory, Brantford, Ont., and the Brantford Starch Company are now putting another storey to their building in order to meet the increasing demands of their business.

—The Kirk-Latty Manufacturing Company, of Cleveland, manufacturers of tacks, trunk cloth and small nails, are talking of locating in London, Ont. The Mann Manufacturing Company, of Brockville, Ont., farm implement makers, have also communicated with the Council regarding inducements to locate a branch of their business there.

PERSONAL—Will Mr. H. Weir, who formerly resided at 42 St Alexander St., Montreal, kindly communicate with us. Any friend of Mr. Weir knowing his present address will oblige by calling his attention to this advertisement. BIGGAR, SAMUEL & CO., Publishers Canadian Engineer, Fraser Building, Montreal.

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ULRIC BARTHE Secretary

Quebec, September 24th, 1898.

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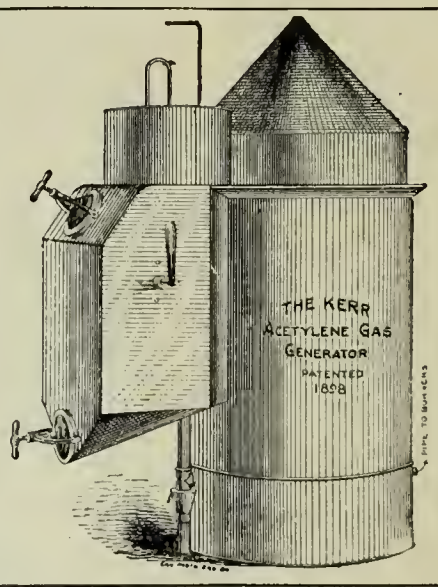

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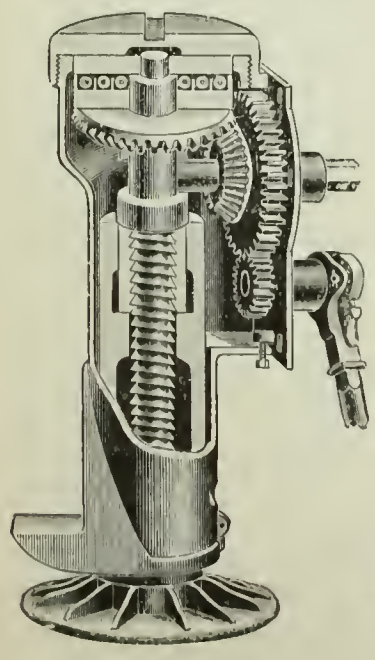

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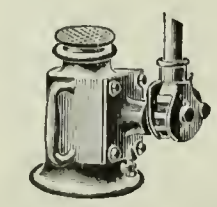

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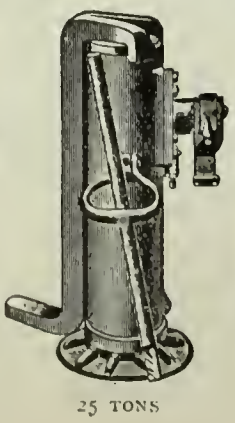

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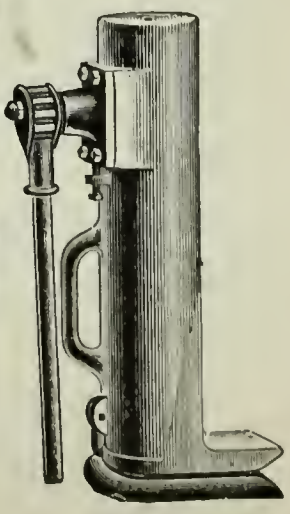

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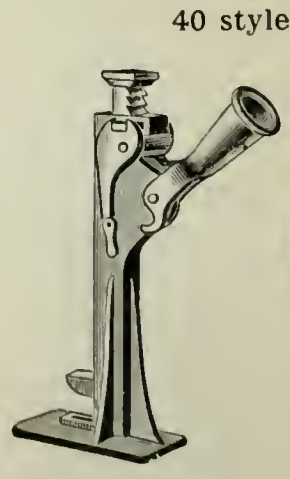

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The Canadian Engineer.

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THE NEW POSTAL LAW.

The Hon. William Mulock comes within an ace of being a great postal reformer. Although not the originator of the Imperial penny postage, the ready co-operation he has given to the plans of the Imperial Government is appreciated throughout all the British Empire, he has brought about many economies in the administration of his department, and last of all, the domestic two-cent rate, which has just come into force in Canada, is the consummation that thousands have long devoutly wished. In order to cover up in part the deficiency which this reduction creates, he has framed a law imposing postage upon newspapers. With such a law in itself we have no fault to find. In fact, the publishers of this journal advocated such a law several years ago, before the present Postmaster-General came into office, but it is just in this law that the Hon. Mr. Mulock fails to be a great man, and discloses either the weakness or shadiness of his public career. The new law is in fact a deception, in that it allows one class of papers to get the benefit of postal service free as before, while it imposes the whole burden of the tax on another class of papers. Whether, as some suppose, the Postmaster-General was moved by a craven fear of the country Press, which forms, in numbers at least, the largest section of the newspapers of the Dominion, or whether he was moved by another motive, we cannot say, but the fact remains that this new law, by creating a zone of forty miles from the office of publication, within which all newspaper matter is free, relieves ninety-nine out of every hundred local papers from the payment of postage, while the newspapers that have a general circulation benefit practically nothing by this exemption.

The Monetary Times shows up the injustice of this arrangement by the following concrete instance: "We know of one case where a journal having a circulation of 4,500 will, by the operation of this Act, benefit to the extent of only 110 copies. On the other hand, a paper having a local circulation of an equal number would pay no postage at all. Mr. Mulock, we are assured, will see the injustice of such an arrangement." We sincerely share in this hope, for a discrimination so unjust was never framed in the history of newspaper laws. As before stated, the whole burden of this tax falls upon one class of newspapers, while another class is permitted to escape altogether. A law founded upon injustice cannot, and should not, stand, and we believe the Postmaster-General has a sufficient sense of right to see that this discrimination is removed.

OILING UP.

BY J. W. WILLIAMS.

In the broad range of the art of mechanics there is no more engaging feature than that of the problem of the reduction of waste power caused by friction, and the extent of these efforts may be measured by comparing the shrieking ox-cart of India and Africa and the ball-bearing axle of the present, with this great extent of improvement in mechanical construction there still remains one feature which seems to have been understood by the wagon driver of a thousand years ago just as simply and as clearly as the engineer of to-day, that is, lubrication. This is an item of knowledge as valuable as many of those which are incidental to machines of all kinds, and one which cannot be overlooked, both from a theoretical and practical value, as proper and improper lubrication raises and lowers the coal bill, and is an item of expense necessary to take into account. The main features of the operation of lubricating may be considered, the conditions and the material.

Attention may be given to the elements which constitute a plant. There is a source of power, a machine possessed of limited force usually in excess of the call or requirement, this may be an engine (steam, gas, or oil), waterwheel, motor, etc., and this machine has to exert its strength in moving the working parts of the plant, the machinery, and execute a varying amount of work. In the effort to overcome the resistance of this work is produced the friction referred to, this friction exists from two causes, the actual weight of the material of the machinery and the pull or stress due to the effort of the motive power to do the work; this latter is the main part of all the friction, the amount due to weight of machinery material becoming less in the ratio of motion at ordinary speeds. The possible loss of power may be imagined from the results of experiments which were tried with a cast iron shaft on a dry bell-metal bearing with the result of a loss of one-fifth of the power, with a wrought iron shaft a loss of one-fourth; these proportions were reduced by lubrication to six per cent. in the first instance and nine per cent.

in the second. These two examples should be sufficient to indicate that "oiling up" is an important part of the care of machinery.

The conditions may next be considered, and the first which presents itself is that of varying pressure and varying speeds and, as important to consider, varying temperature ; these are the conditions under which a lubricant is required to work, and to meet these it should possess sufficient body to withstand pressure, and to be fluid and free running for speed. The qualities which we may look for in a lubricant are a freedom from injurious elements, abrading or corrosive, and having stability in that it will not solidify in the cold nor evaporate in the heat, this latter tendency producing two results, either the total loss of the lubricant, or what is called gumming, which is part of the lubricant evaporating and leaving the solid portion in the bearings ; this latter is a characteristic of vegetable substances, the total evaporation occurring with mineral oils of light grade. The corrosive nature referred to occurs with animal products, these having a greater tendency to rancidity and also requiring more chemical treatment to bring into condition and thereby being in greater danger of being tainted with corrosive impurities.

We need not consider the long list of substances which have been used as lubricants, solid, liquid, dry, wet, thick, thin, clean and dirty, for all these have been features of the various lubricants which have had their place in the markets, but we may be satisfied that in the animal oils and greases, with their great range of body, their freedom from impairment by atmospheric action and other physical changes, that we may obtain a lubricant fitted especially for our requirements, but it lies with the users to examine them in practice for the features enumerated, and, what will be found the main cause of dissatisfaction, misuse of them must be corrected. It is within bounds to say that the use and not the stuff is what is wrong, and in this direction should improvement be sought, with a better attention to bearings to keep them *steadily* supplied ; three cents a gallon cut obtained on an oil is nothing to boast of if thirty cents worth of coal be used instead of the oil.

THE ELECTRIC LIGHTING OF TRAINS.

ROBERT A. ROSS, E.E.

Electric train-lighting is occupying the attention of the larger railway companies on this continent at present to a large extent, and in a number of cases has been adopted for the better class of train service. In Europe the development has been much more rapid and on many lines it has or is in process of displacing the oil and gas formerly in universal use. The reason for the change is not far to seek. The public demands the utmost luxury when traveling, and having been educated to the advantages of electric lighting at home is quick to appreciate the same advantages on the railways where at the present time it is counted a luxury, but will soon become a necessity. The public recognizes the fact that as the electric lamp is free from flame there is no risk of fire and no vitiated atmosphere to breathe and it has an illuminant and not a mere gloom disperser as with oil and gas. Its ready adaptability to being placed where wanted makes possible the use of reading lights in the seats and in other positions where any other form of illuminant would be impossible.

The railway companies are not slow to appreciate these advantages, but naturally wish to be assured that electrical illumination will not be more costly and less reliable than other methods. As regards the cost, from recent experiences of different companies it appears that it is at least as cheap as gas and more expensive than oil. That this inferiority in point of cost as compared with oil will not hinder its introduction is evident, for oil has superseded candles although more costly, and even if electric lighting were more expensive than gas its acknowledged superiority would render its use advisable. As regards reliability, which is certainly equally important with cost, the apparatus used in all systems of electric lighting is practically identical with that used for the illumination of buildings and should be as reliable in operation.

Storage batteries at the present time are thoroughly commercial, as are the dynamos and generating apparatus, In the case of axle driving some complication in the regulating apparatus may exist and it is particularly at this point that a careful selection of apparatus is essential. The several systems in practical operation may be divided into two general classes, the first where each car on the system is independent and capable of taking care of itself. and the second where each car is dependent upon some method of charging located either upon the train or at certain points along the line. The first class necessitates the use of an axle-driven dynamo under each car with sufficient storage battery capacity to carry the lights over the periods when the train is not in motion or running too slowly to

JOHN GALT, C. E., CITY ENGINEER, OTTAWA.
A Biographical Sketch appeared in the December Issue.

enable the dynamo to light the car. Generally speaking the operations of this equipment is as follows : When the train is at rest or running under fifteen to twenty miles per hour the battery operates the lights, when the speed mentioned is reached the dynamo having attained the proper voltage is automatically connected to the lights and battery through the operation of a governor or electro magnetic mechanism, and the battery is charged and the lights operated from the dynamo. To regulate the voltage which would increase in proportion to the increase of speed of the train if not controlled, two general methods are adopted, either by keeping the speed of the dynamo constant or by regulating its field strength. The first is attained where the machine is belt-driven by allowing the belt to slip, the amount of slip being governed by some form of belt-tightening arrangement. This, while apparently unmechanical at first sight, works well in practice, and has the merit of extreme simplicity. Where the dynamo is rigidly geared to the axle the system of the regulation of the field strength to vary in inverse proportion to the speed is adopted, which may be done either by an automatically controlled resistance in the shunt field, by changing the resistance of the magnetic circuit of the field magnet, or by a system of differential field winding. By the above system each car is a separate and self-con-

tained unit and may be attached to any train on any line. Under the second class, where each car is not a separate unit but is dependent upon outside assistance, there are two general systems, the first where the car equipment consists of storage batteries alone, which are charged at suitable stations along the line, and second, where either an engine and dynamo unit driven by steam from the locomotive boiler or a separate boiler in the baggage car, or an axle-driven unit for the entire train is located in the baggage car. Where the simple storage system is used each car is dependent upon obtaining charged batteries at regular intervals and its travel is limited by this consideration. Where the baggage car equipment is used the train is the unit, and except for short intervals determined by the capacity of the battery installed on each car the unit must be maintained intact and the entire train must be wired, at least for the main conductors for through connection to the last coach. In the case of through trains, where the amount of disconnection is small during long runs, the batteries might be dispensed with and dependence placed upon the generating unit in the baggage car, or a single set of cells used in the baggage car or last car of the train to carry the lighting over the periods of disconnecting of the engine or baggage car.

As regards the initial cost of these several systems the writer, after a careful investigation of what has actually been done and what can be done at prevailing prices, has come to the conclusion that the order of cost is about as follows, beginning with the cheapest :

1. Engine and dynamo unit in baggage car without batteries.

2. Engine and dynamo unit in baggage car with batteries under each car.

3. Single axle unit in baggage car with cells under each car.

4. Battery equipments under each car with charging stations at intervals.

5. Separate axle units and batteries under each car.

The last two are not far apart in initial cost per car It may be pointed out, however, that allowance has been made for charging stations on the understanding that they are not used for other work, but in many cases the companies have lighting plants already established which are available for charging, which would diminish the cost of the charging station plan considerably. As regards reliability any of these systems to be commercially successful must be capable of being placed in the hands of the train crew, the supervision of experts being only available at large terminal points, and the expert supervision necessary should not be great even when available, and this will be secured by the use of the system which requires the least apparatus on the cars. This condition is best met by the charging station system where the batteries are inspected after each run and the charging apparatus is under competent supervision. The chances of failure are greatest on the systems employing the axle units for charging, but even in this case from the reports of several companies the failures are few. Regarding the comparative cost of operation of the various systems it is impossible to speak generally, as each is dependent upon the local conditions on the particular railway system under consideration. It may, however, be pointed out that the interest and depreciation accounts, if properly allowed for, will be the largest item in the cost, and the investment in the original instalation will to a large extent govern the annual cost per car for its operation. This acts against the charging station scheme because of the large number of batteries used, and on them the depreciation is larger than on the rest of the apparatus.

The voltage employed where batteries are used should be kept as low as possible with due regard to the wiring losses, to take advantage of high efficiency lamps and to reduce the weight and cost of the batteries as much as possible. In practice the voltages range from 24 to 60 and in many cases 2.5 watt lamps are adopted; the decreased life of these being compensated for by the smaller size of battery and charging apparatus. Where axle units are used the problem to be met approximates in a small way to that of street railway motors which are operating under the floor of a moving car and subject to the shock and disturbance of the motion, but the amount of attention which they will receive while operating is less than in the case of the motor.

To sum up the relative advantages of the several systems in a general way we may say that the system employing a steam unit in the baggage car without batteries is the cheapest and is very simple in operation, but when the locomotive is uncoupled the lights are extinguished, for which reason batteries under each car are a necessity unless the train is never broken. The batteries need, however, be but small. A single axle unit in the baggage car is in a good position for operation without chance of failure, but requires somewhat larger batteries on each car than the steam unit system to carry the lights while the train is stopped or running slowly. Each of the above systems requires that the train be wired throughout from car to car. The advantage of the separate axle unit under each car is that each is independent and no through wiring is necessary, but the initial cost is higher, and the necessary supervision greater than those previously mentioned. The charging station plan is simpler in operation, but its initial cost is high, and its operating costs probably higher than any of the others for the same conditions. It may be pointed out that where any road is contemplating the use of electric light the natural course is to proceed cautiously and invest as little as possible until success has been demonstrated, and for this reason the separate axle unit has an advantage, as only those cars upon which the system is to be tried need be fitted up, while with the other systems expense has to be incurred for wiring all cars or establishing charging stations.

These are merely general views and should not be applied indiscriminately to all cases, as the local conditions of each road will modify the above conclusions profoundly, each case requiring a careful study of existing conditions to ensure that the best system is adopted to meet the requirements. Under the varied conditions of traffic each of the above systems has its place and with the possible conditions met by such varied systems it is not too much to hope that the train of the immediate future will be the electrically lighted.

THE EVILS OF INTERCEPTION TRAPS, ETC.

BY W. M. WATSON.

In the July issue of THE CANADIAN ENGINEER I gave an epitome of the sanitary experiments carried out by the authorities of the city of Cologne, Germany, that proved that it was both dangerous to the public health and in direct opposition to sound sanitary science, to place interception traps on private drains and useless vent pipes on the interior house plumbing arrangements.

Another paper on "Sanitary Excesses" in your September issue showed that the engineers and surveyors of Old London who had pressed the American drainage obstruction system on their employers, the public authori-

ties, plainly saw that a serious mistake had been made, and, that after the aerating advantages of the old draining system were discontinued, that all the public sewers and private drains were simply turned into putrefaction chambers or receptacles for breeding diseases, and that the foul gases generated in the sewers invaded the houses and streets, and that they, the engineers and surveyors, were meeting together to find out a plan to crawl out of the difficulty without tarnishing their former reputation.

The model by-laws, as they call them in Great Britain, or town laws compelling property owners to place the interception trap on their drains and to have useless vent or back air pipes attached to all the house traps, has only been enforced for a very short time, and in a few towns of Great Britain, but the injurious effect of such dangerous innovations was soon felt, because the people are more crowded together there than out here, and the highest sanitarians and engineers have begun to speak out boldly against such cruel and expensive model by-laws, and considerable valuable information has been published in the engineering and sanitary journals of Great Britain proving the injurious effects on the public health.

The lectures and debates of the 17th annual Congress of the members of the Society of Sanitary Science, held lately at Birmingham, England, dwelt largely on the evils of the interception trap and the excesses that have crept into plumbing and draining work. W. Henman, Esq., F.R I., B.A. Sc., etc., chairman of the Sanitary Section of the Congress, in his opening speech stated that the day would come when all interceptors and traps would be abolished, and with them the sewer gases which the interceptors had retained about our dwellings. He proved, during the delivery of his address, that public engineers and surveyors had deeply sinned against the public in the construction of public sewers, because, instead of aiding a rapid removal of sewage and refuse by water carriage, nearly all the sewers they constructed acted as filters or separators, invariably leaving the solids in the sewer pipes to fester and become offensive and dangerous to the public health.

Dr. Bostock Hill at the same meeting showed the falsity of using drain pipes too large for the flow and placing interception traps on the private drains. He stated that the smallest waste or drain pipes which will convey the necessary quantity of liquid intended to pass through are certainly the best for reasons of cleanliness and flushing. From a single house a 4-inch drain is ample, yet Mr. Bostock says he has known public surveyors insist on having a 6-inch pipe and interception trap installed instead of a 4-inch, stating that they compelled the larger pipe because there was less likelihood of the drain becoming choked, which cannot be true, and there are many other disadvantages that tell against using too large a drain pipe, viz., from small houses solids and sewage are chiefly sent down in gushes, the pipe itself, if it is 6 inches, can never be nearly full, and the crown and upper half of the sides only get splashed, so that dirt and filth accumulate and set up putrefaction and generate dangerous gases. Continuing his address on the interception trap he states that when the trap is put in the main line of the private drain a ventilation pipe has to be installed somewhere near the surface of the ground, near the house, to ventilate the private drain and house waste pipes, and in that case the following evils must of necessity occur, viz., each syphon or dip on the trap holds a quantity of foul water, and where water closets are used fœcal matter lodges in them, which generates poisonous gases that take the easiest way out to the open air, which is through this breather or private ventilation pipe. This same breather delivers the accumulated contents of putrid gases each time the house sewage is rushed down the waste pipes and private drain. By these two methods alone a large amount of putrid and poisonous gases are discharged into atmosphere near the windows and doors of private dwellings, causing constant smells, and if some of the dwellings have fever in the place, and the stool of the patient is sent down the sewer, then the foul gases discharged from the breather pipe or air inlet at this time is dangerous and will spread the epidemic. It is certainly undesirable to store sewage even in such small quantities as the amount that lodges in the dip of a trap near inhabitable premises, and I am strongly of opinion that the system of placing interception traps and other impediments in waste and sewer pipes induces a state of things that, from a sanitary point of view, is very much worse than the system which the modern model by-laws have superseded. These are the opinions of a public health officer in England, and many of his associates are fully in accord with him, but I will not weary the readers with repeating their speeches, but proceed to give the results of the tests made by Dr. Porter, M.D., showing the resistance of traps to the freedom of the flow of water and solids when flushing water closets, because it is further extending the experiments begun at Cologne and proving another reason why their adoption is injurious to the public health. Dr. Porter shows by his experiments, what amount of water it takes to flush a water closet properly and prevent the private drain from becoming little better than an elongated cesspool, and states that to gain a thorough knowledge of the requirements of house drains he made 120 test experiments by flushing on the lines laid down for such purposes by the Sanitary Institute in 1893. The class of water closet he used was Duckett's wash-down closet having an S trap and a Unitas washout closet, flushed by a water waste preventing cistern graduated for a flush of 6, 4, 3½, 3, 2½ and 1½ gallons of water at one flushing, and connected to the basin by 5 feet of 1¼-inch lead pipe. The water closet in each case discharging through 47 feet of glazed earthenware 6-inch pipe and again through the same length of 4-inch tile piping to an interception trap, the usual quantity of fœcal matter and paper used being supplied from a factory privy. The weight of the quantities at one flushing being 4 ounces, 6 ounces, and in a few trials 8 and 12 ounces used at each flushing. The first series of trials (fifty in number) were made with a 4-inch drain (fall 1 in 40) and 4-inch disconnecting trap. This trap was filled by 4 pints of water and at the lowest part measured 3½ inches transversely and 4 inches vertically. Flushes of 3, 2½, 2 and 1½ gallons were employed, the result being that 3 gallons invariably sufficed to thoroughly flush closet, drain and 4-inch trap; a 2½ gallon flush generally failed to clear the 4-inch trap; with 2 gallons the interceptor was not once cleared, and most of the solids were left in the trap. By repeated 2-gallon flushes in rapid succession, causing a head of water in the drain, the trap was eventually cleared with a rush, but this did not happen if one flush were allowed to trickle away before the next followed it. A 1½-gallon flush was found to be of little use. The drain was never cleared and became rapidly blocked.

The second series included twenty-one experiments, and was made with a 6-inch drain (fall 1 in 60) and 6-inch disconnecting trap, which, it is noteworthy, required 12 pints of water to fill it, and at its lowest part measured 5⅛ inches transversely and 5⅜ inches vertically. Flushes of 6, 4, 3½, 3 and 2½ gallons were used, and it is a remarkable fact that, though 3 gallons and upwards sufficed to clear

the closet and drain each time, the 6-inch trap was cleared by a 6-gallon flush in only two out of four cases ; 4 gallons cleared it in only one out of six cases, and anything less than 4 gallons altogether repeatedly failed to clear the trap.

The third series numbered twenty-two experiments with a 6-inch drain and a 4-inch intercepting trap. With a 3-gallon flush the closet, drain and trap were efficiently cleansed every time, but a flush of less than 3 gallons failed each time to clear the drain and to reach the trap.

The fourth series (eighteen trials) with a "Unitas" washout closet, 4-inch drain and 4-inch interceptor, flushes of 3, 2½ and 2 gallons being used ; 3 gallons sufficed to clear the trap in two out of six cases. With smaller flushes the trap retained a portion of the charge in every case ; in five cases the drain was not cleared, whilst in eight the closet trap was not cleared, due evidently to the inherent faults of the washout closet. I shall be pleased to supply fuller details of these results to anyone interested in the matter, and I venture to submit the following

CONCLUSIONS.

(1) That 3 gallons is the minimum amount that can be relied upon for efficient flushing—*i.e.*, prompt carriage of dejecta through closet, drain and interceptor to sewer even with a good form of washdown closet well laid, 4-inch or 6-inch drain, and good 4-inch interceptor. (2) That if an inferior type closet be used, or if the intercepting trap exceed 4 inches in diameter, 3 gallons is clearly not sufficient for effecting flushing. The proper remedy then, however, is to correct such structural deficiencies rather than to increase the flush. (3) That if no intercepting trap be employed a flush of 2½ gallons is the minimum amount that can be relied upon to efficiently cleanse the closet trap and drain. (4) That the invariable employment of a disconnecting trap, as recommended by the model by-laws, is far from being an unmixed benefit, and, owing to the obstacle the disconnecting trap presents to the cleansing of house drains, its use should be strictly limited to those dwellings inside which a drain opening exists—*e.g.*, in the cellar—and that if such drain openings inside houses were prohibited in new dwellings, disconnecting traps might, with great advantage, be entirely dispensed with. There i much reason to believe that we have hitherto exaggerated the potency of sewer air ; assuming, however, that it is noxious in its effects, the object of a disconnecting trap is wholly gone if we keep all drain openings outside our dwellings ; and having done this, it is absurd to continue to insist on disconnecting traps, which only diminish the efficiency of the flush of water.

This is the opinion of Dr. Porter, an eminent authority on sanitary matters. If our readers turn up the back number of April, 1897, they will find an article on sanitary appliances, showing how cellars and basements can be properly drained without the drain entering the premises. this is the way Dr. Porter suggests they should be.

PETROLEA WATERWORKS.

The Board of Water Commissioners, Petrolea, Ont., has presented a statement of receipts and expenditures for the year ending November 30th, 1898, that is most encouraging, and considering the prospects for the future the chances are that next year the works will be self-sustaining. These works were constructed in 1896 and 1897, and have been in continuous operation since January, 1897, although not fully completed until a few months later ; they were fully described in THE CANADIAN ENGINEER for November, 1897. Few people, even in Petrolea, believed that a town of less than 6,000 population could afford to spend $172,000 on a waterworks system, and many prophesied that the works would not only be a failure financially, but that they would not be a success mechanically. The town engaged as engineer Willis Chipman, of Toronto, to design the system and to superintend construction. The cost was kept well within the estimates and within the amount raised by the sale of the debentures. Not only has the cost of all the service pipes, but the cost of all the extensions of mains laid in 1897 and 1898 has been paid out of the amount raised by the sale of original debentures.

The town of Petrolea in 1893 entered into an agreement with a private company to put in works on the franchise plan, but the company not succeeding in finding an available source of supply near the town failed to complete the works after laying two miles of pipes. By this

PETROLIA WATER WORKS, 1890.

agreement the town was to pay $4,900 per year for 70 fire hydrants. Upon the recommendation of their engineer in 1895 the town decided to construct its own works and go to Lake Huron for its water supply, a distance of twelve miles in a straight line from the town hall, pumping the water over a rise of 150 feet above the lake to a water tower in the town, its base being 87 feet above the lake level. The size of the main to be laid from the lake to the town, the protection of the intake on the fully exposed lake shore, the class of machinery required and the probable necessity of filtration, were all important problems with the town council, and other engineers were called in to report upon the plans, but their recommendations were not followed and the works were constructed as originally designed. The intake has now stood two winters without injury, the water supplied has given the best of satisfaction to the citizens, the cost of pumping, owing to the high class of machinery adopted, has been no greater than in many other places where the pumping station is not distant more than a mile from the town, and there have been no breakdowns since the works were started.

The commissioners report the receipts from consumers as $8,800 and they allow for fire hydrants only $4,000; making a total revenue of $12,800 for the year ending November 1st, 1898. The operating expenses for the year have been $3,560, leaving a balance of $9,240. The interest and sinking fund charges amount to $9,947 per year, and the net revenue is now $9,240. If the amount the town agreed to pay the private company for fire protection were substituted for the $4,000 the works would now be self-sustaining, and it is evident that in a year or more they will be so even with the present allowance for fire protection.

With the present low rate of interest for municipal debentures every town can afford to construct a system of waterworks, but it will be found to pay to put in a general sewerage system at the same time.

ONTARIO WATER WORKS SYSTEMS.

We are indebted to Willis Chipman, C.E., Toronto, for data upon which the following valuable tabular history of water works systems of urban municipalities in Ontario for the past fifteen years has been compiled. Cities of 20,000 and over, in which large sums had been spent in a long series of years previously, have been omitted. A separate list is given of water works constructed by private corporations and afterwards acquired by the municipalities; and of water works built by private companies and still operated by such companies. The list will be a valuable one for reference purposes.

WATER WORKS BUILT BY MUNICIPALITIES.

	Pop.	Date.	Cost.	Engineer.
Alexandria	1,700	1895	$23,000	Potter, Alex.
Amherstburg	2,300	1891	25,000	Galt, John
Aylmer	2,200	1891	17,000	Milne, Alex.
Alliston	1,400	1892	.....	.....
Beamsville	900	1895	14,000	.....
Beeton	800	1892	20,000	Galt John
Bracebridge	1,400	1894	20,000	Brough, W. C.
Brampton	2,500	1882	65 000	.....
Brantford	17,000	1883	230 000	Cole, J A., & Jones, T. H.
(Small works, built by a private company for fire protection, were purchased by the city in 1888).				
Cambellford	2,500	1890	19,000	Galt, John
Collingwood	5,000	1890	79,000	Galt, John
Deseronto	3,500	1896	35,000	Butler, M. J.
Dunnville	1,800	1891	5,000	Galt, John
Essex	1,700	1891	31,000	Galt, John
Fort William	3,000	1898	36,000	Galt, John
Galt	7,000	1891	157,000	Chipman, Willis
Gananoque	3,000	1892	20,000	Chipman, Willis
Goderich	4,000	1888	68,000	Chipman, Willis
Georgetown	1,500	1891	40,000	Warren, Jas.
Huntsville	1,200	1897	20,000	Roberts, V. M.
Kingsville	1,400	1894	.....	Newman, Wm.
Leamington	1,900	1891	16,000	Bell, J A.
Markham	1,100	1891	10,000	.....
Meaford	2,000	1892	22,000	Sing, J. G.
Merritton	2,000	1888	78,000	Monro, Thos.
Milton	1,500	1888	20,000	Bell, J. A.
Morrisburg	2,000	1887	26,000	Kennedy, Wm.
Mt. Forest	....	1898	25,000	Galt, John
Newmarket	2,200	1886	20,000	.....
Niagara Falls	4,000	1890	77,000	Kennedy, Wm.
(The original works, built and owned by a company, were purchased by the town in the year given, and the works rebuilt and extended).				
Niagara-on-the-Lake	12,500	....	35 000	Galt, John
North Bay	2,000	1892	38,000	Galt & Rourke
North Toronto	3 000	1892	40,000	Venables, J.
Orangeville	4,000	1895	50 000	Chipman, Willis
(Small works built originally for fire protection on the main streets. Rebuilt and enlarged in year given).				
Orillia	5,000	1892	.. ..	.....
Owen Sound	7,000	1890	125,000	Kennedy, Wm.
(The original works, built and owned by a company, were purchased by the town in the year given, and the works rebuilt and extended).				
Paris	3,500	1884	40,000	Bell, J. A.
Parry Sound	2,000	1892	35,000	Galt, John
Penetanguishene	2,200	1891	30,000	Galt, John
Pembroke	4,500	1893	56,000	Chipman, Willis
Petrolea	6,000	1896-7	170,000	Chipman, Willis
Picton	3,300	1889	33,000	Bolger, T.
Port Colborne	1,500	1898	16,000	Witmer, J. F.
Port Hope	6,000	1895	50,000	Stuart, J.
(Small works built originally for fire protection on main streets. Rebuilt and enlarged in year given).				
Renfrew	3,000	1897	52,000	Chipman, Willis
Sandwich	1,500	1891	19 000	.....
Shelburne	1,200	1890	13,000	.....
Stouffville	1,400	1897	22,000	Galt, John
St. Thomas	11,000	1891	150,000	Bell, J. A.
(The original works, built and owned by a company, were purchased by the town in the year given, and the works rebuilt and extended).				
Sudbury	1,400	1896	.....	Gordon & Rourke
Tilbury Centre	800	1888	16,000	.....
Toronto Junction	5,000	1889	180,000	Venables, J.
Welland	2,500	1888	32,000	Kennedy, Wm
Wiarton	2,000	1889	30,000	Ronald, J. D.
Woodstock	9,000	1892	150,000	Keefer, T. C., & Davis, W. M.
(The original works, constructed for fire protection, were rebuilt by the town in 1892).				

WATER WORKS BUILT BY PRIVATE COMPANIES AND ACQUIRED BY THE MUNICIPALITIES.

	Pop.	Date.	
Barrie	6,000	1891	Town purchased in 1898 for $78,000. Willis Chipman, engineer for town.
Berlin	8,000	1888	Town purchased in 1898 for $102,000. Willis Chipman and H. J. Bowman, engineers for town.
Brantford	17,000	1870	Purchased by the city for $63,000.
Brockville	9,000	1884	Town purchased in 1882 for $129,000. Willis Chipman, engineer for town.
Chatham	9,000	1891	Town purchased in 1895.
Cornwall	7,000	1886	Town purchased in 1887 for $86,000. Willis Chipman, engineer for town.
Kincardine	2,600	1890	Purchased by town in 1894 for $45,000.
Niagara Falls	4,000	1884	Purchased by the town for $17,000.
Owen Sound	7,000	1880	Purchased by town for $35,000.

WATER WORKS BUILT BY COMPANIES BUT NOT YET ACQUIRED.

	Pop.	Date.	
Belleville	10,000	1888	City now negotiating to purchase.
Cobourg	5,000	1888	.....
Iroquois	1,500	1886	.....
Ingersoll	4,000	1891	.....
Lindsay	6,500	1892	.....
Napanee	4,000	1888	.....
Perth	3,500	1897	.....
Waterloo	3,000	1889	.....

CARBOLITE.

Of "Carbolite," the recent invention of Hartenstein, of which accounts have been published in the technical papers, The Engineering and Mining Journal says: "The material which he produces and calls carbolite is a biproduct in iron smelting, and is claimed to be a cheap substitute for calcium carbide, being of the same nature as the latter; it is claimed that the profit in producing it from blast-furnace slag promises to be so great that the pig iron may then be regarded as a biproduct. It is a calcium-aluminum-silicon-carbide. The slag is taken directly from the furnace blast in converters like those used in steel-making, impregnated with pulverized coke by means of a gas-blast, and the mixture brought into contact with carbon bars through which a current of electricity is passed, which generates the intense heat required to produce the carbide. It is shown that these claims are misleading. Such slags contain at most only 50 per cent. of lime, and the carbide thus produced would be very poor substitute for the calcium carbide; the silicon in the slag would form carborundum, which gives off no gas on the addition of water; the aluminum would form aluminum carbide, which, with water, evolves the methane, which is only faintly luminous, it being like natural gas; the iron oxide would form iron carbide, and would add another impurity. The mixture would therefore contain so many non-gas-making impurities that it would only produce a small amount of illuminating gas as compared with the calcium carbide. Moreover, the production of these useless impurities costs electrical energy, and it is doubtful whether the saving in heat due to using the already heated product would offset the waste of electric power. It is, moreover, doubtful if this material could be made without infringing on one or more existing patents.

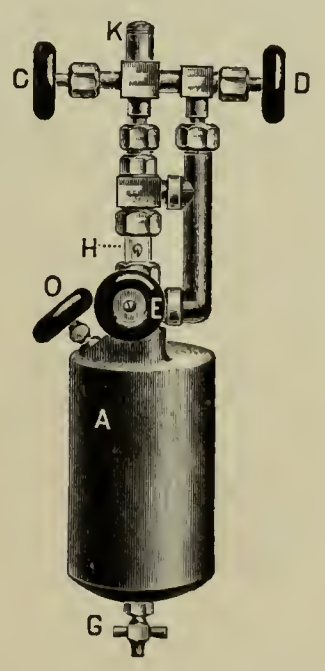
CANADIAN SOCIETY OF CIVIL ENGINEERS.

The thirteenth annual meeting for the election of the council for 1899, and the transaction of other business, was being held in the Society's rooms, 112 Mansfield street, Montreal, as we went to press; a full report of the meeting will appear in the February issue of The Canadian Engineer. The following is the programme: Tuesday, January 10th.—11 a. m., meeting for the election of scrutineers in the Society's rooms; 2 p.m., excursion from the Bonaventure depot to the New Victoria bridge, by courtesy of the Grand Trunk Railway; 8 p.m., meeting in the

Society's rooms, paper upon the construction of the new Victoria bridge prepared under the direction of Joseph Hobson, chief engineer, Grand Trunk Railway, illustrated by lantern projections. Wednesday, January 11th.—Excursion of the Society to visit the works of the Laurentide Pulp Company, Grand Mere, for which a courteous invitation has been extended by the company. Thursday, January 12th.—10 a.m. and 2 p.m., technical meetings in the Society's rooms, at which the following illustrated papers will be read: The Soulanges Canal, by Thos. Monro, past president, Can. Soc. C.E.; the Trent Canal by R. B. Rogers, M. Can. Soc. C.E.; the Georgian Bay and Ottawa Ship Canal by H. K. Wicksteed, M. Can. Soc. C.E.; 8 p.m., members' annual dinner, at the Windsor hotel. Friday, January 13th.—10 a.m. and 2 p.m., business meeting and an address by the retiring president, W. G. McN. Thompson.

THE PREVENTION OF SCALE IN BOILERS.

In an article in the November issue of The Home Study Magazine, in answer to the question, "Will carbonate of soda or plain soda remove hard sulphate of lime scale?" the expert replies, "I have never found it to be much good for that purpose. I can tell you, however, what will remove it pretty effectually—very cheaply too—and that is ordinary kerosene. If this is fed to the boiler at the rate of about one-quart per day per 100 h.p., the benefit to the boiler will soon be apparent. It has also been found to prevent, to quite an appreciable extent, the formation of hard scale. Its action upon the sulphate of lime does not seem to be a chemical one, however, but rather a mechanical action. In my opinion, the minute particles of sulphate of lime precipitated by the action of heat, are first carried to the surface of the water by the boiling and bubbling of the water. There they become coated over with the kerosene, which prevents them from uniting into a solid mass when deposited on the plates." This may be accepted as the opinion of one of the most advanced United States engineers it is claimed. In order to get the benefit of the scale removing properties of kerosene, it is necessary to introduce it into the boiler drop by drop, and for this purpose a special device has been constructed. One of the best known and most widely



used of these is that shown in the accompanying cut, made by the Detroit Lubricator Co., of Detroit, Mich., and known as the Detroit Kerosene Oil Injector. Besides being extensively used in the United States, several thousand of them have been sold in Europe. For more than two years past the Vienna Dampfkessel untersuchungs und Versicherungs-Gesellschaft have been conducting a series of experiments with these Detroit kerosene oil injectors, and their report has recently been published. It agrees with the American opinion cited above, but it is more detailed and specific. It states, for instance, that "kerosene injected by way of drops with the feed water comes into the boiler as an emulsion, and remains waving in the water. The evaporating process separates the pulverized scale, which gets covered with a thin hide of oil, whereby the sticking to the wall is diminished." In regard to its action on the scale already formed, a very interesting explanation is given. On account of its peculiar nature, the kerosene penetrates into the scale, which being a very bad conductor of heat, is much hotter at the shell than on the water side. As the minute penetrating particles of kerosene get deeper into the scale they become hotter and hotter, till finally they become changed into a gas, and the resulting expansion bursts off pieces of the scale, just as dynamite does in a mine, and this process continues until all the scale is removed. As scale is one of the most annoying troubles of steam plants everywhere, this method of disposing of it, being both cheap and effective, will doubtless be very generally taken advantage of.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A. ROSS, E.E., M. CAN. SOC. C.E.

(Concluded).

Having sketched in a general way the points to be considered and determined upon the general features of the transmission, we may take up the figuring of lines, efficiencies and horse-powers to be generated. To do this, certain assumptions must be made as to the allowable efficiencies of the line and apparatus at various loads, which has been done in the tables below. As regards the apparatus, commercial efficiencies have been assumed, which are usual for this class of work, and will be guaranteed by the manufacturers. The line efficiencies are what would be usually allowed, considering the copper as designed for those efficiencies at maximum demand.

	Loads.			
Transmission (generator to sub-station).....	100%	75%	50%	25%
Generators.....	96	95	94	90
Line.....	90	92.5	95	97.5
Raising and lowering transformers.	96	95	94	90
Total efficiency of transmission	83	83	84	79
Incandescent (distribution to lamps).				
Primary distribution at 2,000 volts..	96	97	98	99
Large reducing transformers.....	97	97.5	97	95
Secondary distribution to lamps . .	97	98	98.5	99
Total efficiency of distribution.	91	92.5	93.5	93
Arc Lighting (distribution to lamps).				
Efficiency of motor.....	92			
Efficiency of arc machine.....	86			
Efficiency of line distribution to lamps.....	93			
Total efficiency of distribution .	72.6			
Power Circuit (distribution to motors).				
Efficiency of lines.....	90	92.5	95	97.5
Efficiency of transformers.....	96	95	94	92
Total efficiency of distribution	86.4	88	87	89.7
Railway Power (distribution to motors).				
Efficiency of rotary transformers. .	96	96	95	90
Efficiency of distributing lines to motors.....	80	85	90	95
Total efficiency of distribution.	76.8	81.6	85.5	85.5

From these efficiencies of line and apparatus the whole power necessary for all the maximum demands may be transmitted at an efficiency of 80% from the generator shaft to the distributing lines in the city. The total efficiency at full load from the generator shaft to the lamps, railway and stationary motors, is 68%, and under the average running conditions would not be less than 70%.

These figures illustrate the remarkable efficiency of electrical transmission even on such a mixed and varying load. It will be noticed that at varying loads the efficiencies are not very different, owing to the fact that, while the apparatus falls off, the line increases in efficiency, thus maintaining a balance. In fact, under light loads the efficiency is higher than under heavy, and is actually higher than given in the totals, because the tables consider the whole plant as operating at fractional load, while in actual running the apparatus would be kept at full load by shutting down units as the load dropped, thus raising the efficiency. The figure of 68% therefore may be safely taken as the lowest to be met with during the course of the year, and as it holds only for the peak of the load will not affect the average efficiency materially. The date assumed or calculated for the transmission is given below. The power is that

necessary at the distributing lines to take care of the maximum demands as shown on the curve of total power. The power factor is assumed to be 100% for the class of load considered, loss in transformers 4%, in line 10%, which is not too high for the peak of the load, as this is what the line is designed for.

Electrical H.P. required at end of transmission line	11,946
Voltage of transmission at end of transmission line	15,000
Periodicity or complete cycles per second	60
Distance transmitted in miles	10
Power factor assumed p. c	100
Loss in transformers p. c	4
Loss in line p. c	10
System of transmission—Three phase	

Figuring the transmission on the above assumptions the actual electrical horse-power at the generator terminals is 13,623, while the apparent horse-power as read by volts and amperes is 13,862. In other words, while the real loss in the transmission is 14% of the power required at the end of the line, the apparent loss is 16%. This shows a high power factor for the whole system, and is obtained by a non-inductive load on a line well sub-divided, and with the wires properly placed.

To illustrate the effect of an inductive load upon the amount of apparatus necessary, another line with a load power factor of 90% has been figured, the other conditions remaining the same as before. This, while having the same losses as in the first case, requires 1,327 apparent horse-power at the generator, necessitating an increase of generating apparatus of 25%, or, in case the plant were installed, it would cut down its capacity 20%, and would decrease that of the distributing apparatus 10%. Were it not for these induction effects the problem would be as simple as in the case of direct current work, but as it is, they affect the matter to a very great degree, and require the most careful consideration to arrive at even a fair approximation to actual results.

Considering the fact that this power is laid down from the wheels with such simple machinery with but at most one revolving part, and therefore requiring no attention when once started, it is not surprising that electricity should have monopolized the field. The efforts at the present time to transmit to longer distances will be successful in proportion as the knowledge of insulating methods increases; and, from the rapidity with which present voltages have been attained from lower formerly prevailing, it is not difficult to foresee the time when this country which is so rich in water-power, will be literally covered with power lines for all purposes. The possibilities in the way of covering an increased territory by raising the voltage may be illustrated by the plant considered above, where, with 15,000 volt and 14% loss, the power covers a radius of ten miles in all directions. If the voltage were doubled, and the same loss allowed, the radius would be 40 miles, and the territory covered would be sixteen times as great. In other words the area served will vary as the fourth power of the ratio of increase of voltage. The question of the advisability of transmitting from a distance the natural power available in preference to generation at the centre of distribution by steam-power requires the most careful attention. The cost of the power laid down on the consumer's premises is made up of two items, namely, fixed charges and operating expenses. The first includes interest and depreciation on the plant, the second coal and supplies, attendance, etc. The saving by adoption of water-power is in coal and supplies, and perhaps a small part of the labor, provided the plant cost the same. Should, however, the cost of the transmission scheme be enough larger than that of the steam to eat up the saving in interest and depreciation on the increased cost of plant there is nothing to be said in favor of the transmission. If there is no cheapening of cost, the steam plant has the advantage of the greater reliability in lines and apparatus, as no high voltages need be used, and there is no risk of troubles with the water-power during the winter such as always exists to a greater or less extent in this climate.

In many cases, however, where the water-power improvement can be made with small outlay per horse-power rendered available, the gain may be large. It is not so large, however, as seems to be the idea of the public, which considers a water-power as capable of producing power for nothing, entirely ignoring the capitalization necessary for development. The transmission and utilization of electric power has got beyond the experimental stage, and is now surrounded with that mystery which used to obscure the financial facts, and the more it is considered as a commercial article depending upon the laws of supply and demand for its existence the more will its usefulness become apparent to the consumer and its financial security appeal to the capitalist.

MECHANICAL DRAFT FOR STEAM BOILERS.*

BY WALTER B. SNOW.

(Concluded from last issue).

We may now consider the influence, from a commercial standpoint, which the application of mechanical draft exerts upon the aggregate first cost of a steam-boiler plant. For this purpose there has been selected a plant of reasonable size of which the detailed cost is known. This plant consists of eight modern water-tube boilers, each of 200 horse-power nominal rating. A chimney is provided, 8 feet in internal diameter, by 180 feet high, of sufficient capacity to overcome the resistance of the two feed-water economizers and produce the draft necessary for any probable forcing of the boilers. The detailed cost of that portion of the plant which concerns the present discussion is in round numbers, as shown:

Eight water-tube boilers, of 200 horse-power each	$25,000
Two feed-water economizers	7,000
Boiler and economizer setting and by-pass	6,000
Automatic damper regulator and dampers	300
Chimney, complete	9,000
Building, complete	11,000
	$58,300

We may then consider the simplified arrangement which is possible when an induced mechanical draft apparatus is substituted for the chimney. There are two fans supported by the economizers, each driven by a separate engine. Each fan is capable of independently producing the draft for the entire plant, and thus serves as a relay is desired. Such an apparatus, with the short stack, can be installed, complete, under ordinary conditions, for about $3,500, making a saving of $5,800.

The omission of one boiler would bring the rated capacity down to 1,400 horse-power, and would call upon the fans to only increase the steaming capacity of the other boilers by about 14 per cent. above the normal, which could be readily done. This would show an additional saving in first cost which may be thus presented:

1,600 NOMINAL HORSE-POWER PLANT.

Cost of 8 boilers	$25,000
Cost of settings, etc.	6,000
Cost of building	11,000
	$42,000

1,400 NOMINAL HORSE-POWER PLANT.

Cost of 7 boilers	$21,875
Cost of settings, etc., about	5,500
Cost of building, about	10,500
Saving by use of mechanical draft	4,125
	$42,000

This shows a possible supplementary saving on the entire plant of $4,125, which makes a total reduction of $9,925 to be credited to the account of the mechanical method.

In any properly arranged plant the exhaust steam from the fan engine would be utilized so that the actual cost of the steam used in producing draft would be reduced to practically nothing. The value of the land may be an important factor in first cost. If figured at $2 per square foot, for instance, the omission of the chimney would in this case save $990, and the reduction in the number of boilers, $960 on the cost of the land required for the plant. The total net saving in first cost of a single plant, under the given conditions, may be thus summarized:

By omission of chimney and damper regulator	$ 5,800
By reduction in number of boilers	4,125
By saving in space occupied by chimney	990
By saving in space occupied by boiler omitted	960
	$11,875

*Abstract of a lecture delivered before Sibley College, Cornell University

This total saving is made possible by the expenditure of $3,500 for the mechanical draft apparatus; that is, the saving is nearly three and one-half times the expenditure necessary to secure it. The reduction of $11,875 in the cost would indicate an annual saving in fixed charges of about $831 to $890, according as the aggregate of interest, taxes and insurance is taken at 7 or 7½ per cent. This amount would, under conditions of the best economy, be practically sufficient to cover the cost of operating the mechanical draft apparatus, provided no attempt was made to utilize the exhaust steam, and would far more than cover it were this steam usefully employed. When to the economical advantages already pointed out is added the increased convenience of mechanical draft, its positive character, its ready adaptability, its independence of climate conditions, and its instant response to any demand for increased steam supply, the account stands decidedly to its credit. Therefore any further saving, as for instance in the cost of the fuel burned, is clear gain over and above any expenditure that may have been made on account of the introduction of this method. As a further factor in the matter of cost it should be noted that the fan possesses a definite advantage over the chimney in that it is portable and is always a valuable asset. The chimney, on the other hand, is a fixture; it is suited only to certain conditions and is practically valueless unless those conditions exist. The ability to utilize cheap fuels is an inherent advantage of mechanical draft, due to the fact that such fuels, being as a rule finely divided, with a large percentage of dirt and ash, require an intense draft for their combustion.

The influence of mechanical draft upon the quality and cost of the coal required is well exemplified in the case of a plant, consisting of three Babcock & Wilcox boilers of 335 h.p. each. The draft is furnished by a blower, which forces the air to the ashpits, and whose speed is automatically regulated by a special device, so that the volume of air and intensity of draft are continually changing to suit the varied conditions and requirements of the fire. Before this mechanical draft plant was put into operation, the fuel employed was George s Creek Cumberland coal, costing $4 per ton delivered. Since the fan has been in use, the quality and price of the fuel has been reduced to a mixture of No. 2 buckwheat with yard screenings and Cumberland, costing $2.62 per ton. The present average saving per week is over $126, when all fuel, including that for banking fires, is taken into account. Finally, in addition to the economic advantages of mechanical draft which have been presented, there are others which relate primarily to the convenience of installation and operation. Prominent among these is the feature of adaptability. The fan, which is usually of steel plate, may be constructed in any shape to meet specific requirements, may be located as desired with regard to the position of the boilers and without expensive foundations, may be used for either forced or induced draft, and because of its portability may be relocated or exchanged for another of different capacity. In its operation the fan is perfectly flexible, may be run at high or low speed, independently of the chimney temperature, and is always susceptible of instantaneous change in response to sudden demands. A mere change in engine cut-off produces an effect only secured with a chimney by adding to its height at great expense. External temperature changes have no appreciable effect upon the operation of mechanical draft, which, above all else, is independent of climatic conditions. The fan is a most important factor in smoke prevention, and in connection with the closed fire-room system the resulting ventilation is of vital importance. Briefly summarized, mechanical draft has here been shown to be capable of reducing the avoidable losses, of decreasing the first cost of a steam generating plant, and of reducing the fuel expense. In addition, it presents certain marked conveniences in the matter of installation and operation. In these days when every step in the process of steam generation and utilization is being scrutinized in the attempt to reduce the cost by even a single per cent. the opportunity presented by the employment of mechanical draft cannot be and is not overlooked. The economical necessity was not so imperative when Rankine and Clark pointed to its marked advantages. And the future was but dimly discerned when, only fifteen years ago, Seaton referred to the chimney as a rough and ready, but exceedingly wasteful way of inducing the air to flow into furnaces with sufficient velocity to cause the fuel to burn, and prophesied that it would some day undoubtedly be superseded by a more scientific and economical apparatus. Mechanical draft now stands so well established in the engineering world as to lead a noted engineer to remark that, "the building of tall chimneys to secure draft simply advertises the owner's lack of familiarity with modern improvements, or his want of confidence in results easily demonstrated."

A NOVEL METHOD OF SEWAGE DISPOSAL, ESPECIALLY DESIGNED FOR THE CITY OF TORONTO.

BY C. G. HORETZKY, C.E.

Upon the assumption of a present population of 205,000 inhabitants,, the city of Toronto pours daily into the bay, and deposits upon the water front directly under the noses of her citizens, and beneath the keels of steamers and other craft frequenting the wharves, twenty tons of solid faecal matter, aggregating, during a year, the enormous quantity of 7,300 tons. To this must be added the solid excrementitious matter derived from stables, byres, slaughter-houses, and other extraneous sources, together with 16,000,000 gallons of excremental and other foul liquids. With the view of ameliorating the present conditions, C. H. Rust, city engineer, in his report of October 12th last, has recommended either of two methods of sewage treatment, i.e., intermittent filtration, the cost of which is estimated to be $730,000; or chemical precipitation, followed by filtration, presumably, through natural soil, at a cost of $550,000. The first mentioned process is estimated to involve an annual charge for maintenance of $70,000; the latter $105,000. Owing to the fact that, under the auspices of the Provincial Government of Ontario, the writer has been the pioneer of sewage treatment in Canada, that he has examined many of the best known plants in the United States, that he is in constant communication with United States State Boards, and is consequently in a position to be informed of the latest methods pursued there, it seems pardonable, in the interests of the community, to throw some additional light upon the very important question of the sewage disposal of this city.

Some time ago I outlined briefly in the columns of The Toronto Globe a method for the partial purification and disposal of the Toronto sewage. I now purpose entering more minutely into details which, since my letter was written, have been developed and elaborated, while the cost of construction and annual maintenance has been more correctly ascertained. The system of intercepting sewers recommended by Hering & Gray, with, perhaps, the slight modifications referred to in Mr. Rust's report, will, of course, be a preliminary necessity, and somewhere upon the line of the high level one in the vicinity of the Eastern city limits, the purification works, which I now advise as most suitable, regarding economy in construction, simplicity, and low cost of annual maintenance, as compared with other methods, should be located. The flow of sewage upon leaving the high level sewer would first pass through a screening chamber, 10 by 20 feet, which would intercept foreign substances, thence the sewage would enter one or more of a series of eight receiving reservoirs, placed in a row, each reservoir being 34 by 40 feet, with graded floors some 18 or 20 feet lower than the sewer invert. These reservoirs would be fitted with metallic screens extending across the whole horizontal cross-section of each reservoir, to support coke strainers, the upper screen of all being intended to intercept all the solid faecal matter, and to prevent the latter from coming into contact with the coke strainers below. In this manner it is estimated that, with the present flow of sewage (16,000,000 gallons), about twenty tons of solid matter will be held back every 24 hours.

After passing through the coke strainers the fluid sewage, now purified to a very large extent, would be allowed to fall into the pump well, the bottom of which is designed to be 8 feet lower than the floors of the receiving reservoirs. This pump well would be about 285 feet in length, and 10 feet in width, with a capacity up to reservoir floor levels of about 140,000 gallons. Immediately adjoining the receiving reservoirs, and partially over the arched roof of the pump well, would be situated the pump and boiler house. The pumping plant would consist of a duplicate set of 24 inch centrifugal pumps. Each pump is calculated to discharge 25,000,000 gallons per 20 hours.

against a total head of 40 feet (which includes the suction lift). The pumps would be run by a pair of 400 h.p. compound engines.

There would be a battery of 10 horizontal tubular boilers; each boiler of 100 h.p. Eight of these boilers are intended to supply steam for the pumps, the other two for drying out the receiving reservoirs and the contents thereof, coke and sewage matter, preparatory to the latter being run into the boiler house as fuel to be used under the boilers. The sewage effluent, after passing through the receiving reservoirs, and having been rid of all suspended and solid matter, would be as well purified as any chemical process of precipitation can accomplish, and could be allowed to pass by gravitation from the pump into Lake Ontario without further treatment, at any depth desirable below the surface, where diffusion would at once take place. But, if still further purification were at any future period insisted upon, either by local boards of health, or Governmental authority, two alternatives are open for such a purpose, viz., either by intermittent land filtration for which very much less than half the area suggested by the city engineer at page 12 of his report, would suffice; or, by the construction of two sets of artificial filters of the following materials and dimensions: Half an acre of coke filters, 3 feet 6 inches in depth; six acres of sand filters, 2 feet 3 inches in depth, the cost of which would not, in all probability, exceed $28,000. The last mentioned artificial filtration areas are larger, proportionately, than the supplemental filters in use at Glasgow, Scotland, for a similar purpose. The first alternative would necessitate the purchase of about 200 acres of land, besides its preparation, also an extra pump, while the cost of the last would be limited to material and construction only, as the sewage effluent would gravitate from the pump discharge to the filter beds.

In immediate proximity to the boilers and receiving reservoirs, there would be a brick chimney 250 or 300 feet in height. The object of such a high chimney is, by a powerful draft and steam heat, to carry off the objectionable fumes arising during the process of drying out the contents of the reservoirs, for which purpose a system of steam coils connected with one or two of the spare boilers is designed. Also, besides ventilating the reservoirs, it performs another very important function during the flow of sewage by creating a tremendous draft from the fresh air inlets upwards, and thus oxygenating the sewage most thoroughly, as the latter falls from one strainer to the other. Each receiving reservoir is capable of passing, and partially purifying from 2,000,000 to 4,000,000 gallons of sewage daily, after which it would be shut off from the sewer, thoroughly drained, and then subjected to a drying temperature of 300° F., which, assisted by the draft of the tall chimney would desiccate in a few hours the coke strainers and several tons of faecal matter intercepted by the upper screen, sufficiently to be used as ordinary fuel under the boilers, to which means have been designed to run them with a minimum of labor.

Such is the brief description of a very simple and economical plant, by which Toronto's sewage problem can be solved; and I wish here to point out particularly that this scheme involves an innovation hitherto unknown, or at least unpractised, so far as I am aware, in any sewage plant anywhere, i.e., the total and profitable combustion of the solids. By this process there is no resulting sludge to press and get rid of at considerable expense, the fuel bill is lessened, while the solid matters disappear in vapor.

It may be interesting to state here that, in any extensive chemical precipitation process the disposal of the sewage sludge has always been found an enormous drawback, as each million gallons of sewage treated produces from six to eight tons of pressed sludge cake, which it has been found impossible to get rid of without extra expense. Were such a system brought into use here, it is no exaggeration to say that the city would find itself compelled to hire daily, either a train of cars, or a small fleet of barges to haul it away. Farmers might take a very small percentage of it, but the great bulk would have to be carried away at the expense of the city, and 16,000,000 gallons of sewage daily treated chemically, mean 128 tons daily of pressed sludge cake. With regard to the coke strainers experience has shown, beyond a doubt, that after drying out, that material is as useful for fuel as before; and I shall show presently how it decreases the fuel bill, after having served its purpose as a strainer in the receiving reservoirs. It should be mentioned that this plant is amply capable of handling 16,000,000 gallons of the dilute sewage of Toronto per day, and that the receiving reservoirs can be added to if necessary; also that each of the pumps will discharge 25,000,000 gallons per day of 20 hours, with ease. The daily consumption of coke for straining purposes would be about 25 tons, or 175 tons per week, and the daily cost of pumping 25,000,000 gallons against a head of 40 feet would be 12 short tons of anthracite coal. Reduced to dollars and cents the daily cost for coke, coal and wages, may be represented as follows:

Pumping, 12 tons coal, steam drying, 3 tons coal; 15 tons coal, say at $3.75		$56 25
Deduct 25 tons coke recovered from reservoirs valued at one-fourth its weight of coal=6.25 tons at $3.75	$23 43	
20 tons desiccated faecal matter, equivalent to 4 tons combustible matter, but not taken into account		23 43
		$32.82

The daily cost for labor would be:

Wages of two engineers at $2.50	$5 00	
Wages of four firemen at $1.75	7 00	
Wages of twelve laborers at $1.75	21 00	33 00
		$65 82
Add 25 tons coke required daily for strainers (high figure) at $4		$100 00
Total daily cost of maintenance		$165 82

Or $60,524.30 per annum

ESTIMATED TOTAL COST OF DISPOSAL WORKS.

Excavation		$30,000
Brickwork		30,000
Concrete		4,200
Iron work		6,000
Drying apparatus, coils, piping, etc.		10,000
Ducts, or flues from receiving reservoirs to chimney		3,000
Flues from boilers to chimney		3,000
Roofing and carpenter's work		4,000
Bricking in boilers (10)		3,000
One centrifugal (24-inch) pump, one pair of 400 h.p. compound engines, 4 horizontal tubular boilers, aggregating 400 h.p.; feed pump, piping to connect boilers and engines, engines and pump set up on foundation, boilers placed ready to be bricked in	$15 000	
In duplicate		30,000
Two additional boilers (steam drying)		2,000
Additional: suction and discharge piping, etc.		1,000
Brick chimney (300 feet in height)		45,000
Coal and coke sheds		10,000
Eight branches connecting sewer with the different screening chambers, fitted with gates, and sundry other items		10,000
		$191,200

Note.—I am indebted to the Northey Mnfg. Co., Ltd., for the estimates as to the pumping apparatus and boilers.

It is important to explain here that the use of coke strainers has not been advocated without good reason. At Lawrence, Mass., U.S.A., experiments by the State Board upon the best known methods of sewage disposal have been tried during the last decade, and the results of the last two or three years, with regard to coke strainers, have shown that a 6-inch layer of that material has purified city sewage at the rate of 1,000,000 gallons per acre daily, and removed 62 per cent. of the organic matters (albuminoid ammonia), and 50 per cent. of that determined as "oxygen consumed," also that, at the rate of 4,000,000 gallons per acre daily, 38 per cent. of the total organic matter has been eliminated. The report of 1896 states emphatically besides, that coke straining removes organic matter as thoroughly from sewage as it is possible to do with any chemical or sedimentation process whatsoever, besides having the advantage of getting rid of the concentrated sludge liquor. It must also be remembered that, in the method which I have now advised, I have gone a step forward, by the retention of the solid faecal matter above, and entirely out of contact with, the coke strainers, thus relieving the latter of a very large per-

centage of organic matter to be dealt with. Obviously this is equivalent to increasing proportionately the area of the straining surface. The total combustion of the solids under the boilers, and the riddance of the expensive and intolerable sludge nuisance, are also advantages which must weigh with, and appeal to, even the least thoughtful of municipal economists.

It has been said that intolerable smells would arise from this combustion process. Not so. The high chimney will cause any bad odors to be carried away and dissipated in the atmosphere, far above the highest part of the city or neighborhood.

I may instance the Townsend and St. Rollox chemical works chimneys at Glasgow, Scotland, besides others in England, Germany, and in the United States, situated in the midst of dense populations, which carry off immense volumes of most deleterious gases, without inconveniencing the people below; but a little consideration will satisfy the most sceptical that nothing need be feared upon that score.

Mr. Rust estimates the cost of 600 acres of land, and the preparation of 300 acres for intermittent filtration, at $240,000. This, of course, presupposes the land to effect the purification of the crude sewage as it comes from the sewers.

My estimate for a filtering area of suitable natural soil, such as is said to be available to the northeast of the city, would be a tract of only 200 acres, which is amply sufficient to effect the final purification of the partially purified effluent from the coke strainers, being at the rate of 160,000 gallons per acre daily, for 16,000,000 gallons of a daily output. Such an area, upon the basis of Mr. Rust's estimate, would certainly cost less than $80,000. In the event, therefore, of a pressing public demand for complete purification, by final filtration through natural soil, entire and thorough treatment would cost, by the method I have outlined, as follows:

Coke straining and combustion works, pumping station etc	$191,200
Land for above (Mr. Rust's estimate)	10,000
Extra pumps, boilers, etc., required for pumping to land northeast of the city	20,000
Force main (Mr. Rust's estimate)	115,000
Two hundred acres of land for filtration purposes, and preparation, being taken at exactly the third of Mr. Rust's estimate. This is manifestly too high	80,000
	$416,200

Which is only 57-100ths of the city engineer's estimate for the cost of intermittent filtration and 75-100ths of that of his chemical precipitation scheme, *which has still the sludge to deal with.* The three proposed processes now stand thus, as regards cost of construction:

Coke straining and combustion process, followed by intermittent filtration	$416,200
City engineer's estimate for intermittent filtration	730,000
City engineer's estimate for chemical precipitation	555,000

And, as regards cost of maintenance per annum:

Coke straining and final purification by intermittent filtration	$65,000
City engineer's estimate for intermittent filtration	70,000
City engineer's estimate for chemical precipitation	105,000

In conclusion, I may remark that the coke straining may be carried to any extent by more frequent changes of coke than I have allowed for, it is simply a question of more coke and less coal, but the quantity estimated (175 tons weekly), will purify quite sufficiently for all practical purposes, especially if followed by intermittent filtration.

RETAINING WALLS.

Editor CANADIAN ENGINEER:

In a communication, published in your journal a year or two ago, I commented on the failure of the Bouzy dam in France, when some 230 persons perished in the flood; I then advocated a thickness of dam equal to the height or depth of the impounded fluid. That and other failures of retaining walls of masonry seem to have brought about a general concensus of opinion among engineers that this is safe practice; and in fact, retaining walls of all kinds, now-a-days, are built in a way more or less in accordance with this view.

Dams of masonry up to the present era used to be made of a thickness hardly greater than one-half the height or depth of water to be held back. This was done under the assumption that the weight of masonry being at least, or even more than, double the weight of water. Such a thickness of wall would suffice to retain it in situ. So it would, if the masonry could continue for all time to remain an homogeneous mass, thoroughly bound together by its cementing mortar. But it is well known now that this cannot or at least does not continue to be the case indefinitely. Whether through time and infiltration or other causes, the cementing medium deteriorates and rots away to sand in the course of years, when the superincumbent layers of masonry become, so to say, dislocated and detached and capable under sufficient pressure of sliding or moving the one upon the other. The friction of masonry on masonry or of one course of stone-work on another may be taken at a resistance, so to say, of 50 per cent. of the weight or vertical pressure; and, as in the case of a stone disintegrated dam of which the thickness is only half that due to the pressure weight on depth of water at any point, the resistance is therefore only equal to or less than that pressure, and the dam must in the course of time give way.

Hence, I advocated, as said before, a thickness equal to the depth of water, as in that case the loose material itself without the binding of it together by mortar, would still be of a weight more than double that of water, and such that its 50 per cent. of frictional resistance would be in excess of the pressure brought to bear against it. I am led to these remarks by an illustrated article in the last issue of The Scientific American, descriptive of a dam now in the course of erection at a point some five miles west of Mateo, a suburb of San Francisco in California.

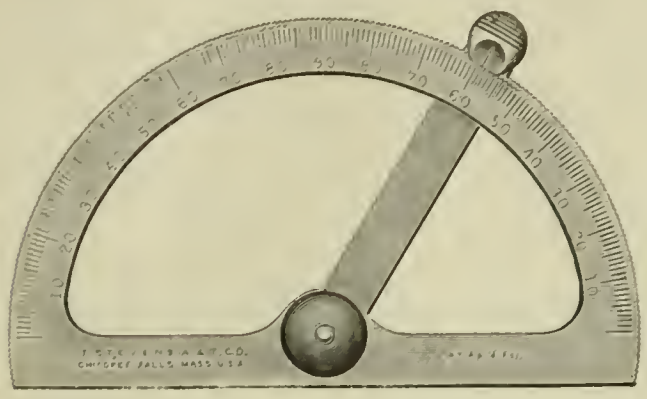
This dam is built of concrete, and is the largest of its kind in the world. Concrete dams were heretofore on the monolithic plan, or as if a solid homogeneous mass of material. Concrete, however, as may be seen, even in floors and sidewalks, is contractile and separates into parts, leaving fissures between them, and thus destructive of the impermeability of a water retaining structure. Hence they are now-a-days built in blocks, and given time to dry and contract before they are cemented together. This is the mode Herman Schussler, C.E., has adopted of doing his work. The component concrete blocks of some 30x40 feet in horizontal area being built in boxes or bottomless caissons, as it were, with movable sides, and made to interlock or dove-tail, the one into the other, thus breaking joint, as the saying is. These blocks are made of the uniform height of eight feet, and every layer thereof left to dry thoroughly and shrink before another layer of similar blocks is laid over it.

The dam alluded to bears out my views, and those of the profession at large, in that its thickness is equal to the height or depth of water to be held up. Its length is, or will be, when finished, not less than 832 feet on top, or at the crest. Its present height is 145 feet and breadth of base 176 feet, or equal to its finished height which, as it has to rise still by 30 feet, will be 175 feet. The thickness at the present height is 40 feet, or some five feet in excess of the depth of water above this point. The dam is curved or convex up stream to a radius of 637 feet, or versed sine, of over 100 feet, and its strength and resistance thus added to materially. The quantity of water impounded will be 19,000,000,000 (nineteen thousand million gallons). The down face slope or batter of the dam is one horizontal to four vertical. The up face slope is one to one, to within 60 feet of its full height, whence it is, like the outer slope, one to four, and the two slopes joined by a curve of a radius of 300 feet. The foundations were excavated down below the original surface to a depth of from 8 to 35 feet, until solid rock was reached, and to guard against fissures in even this, a trench was further sunk to a depth of 17 feet with a width of 5 feet at bottom and 10 feet at top, and this filled with concrete solidly rammed down with heavy iron rammers. This trench runs the whole length of the dam, following of course its curvature and reaching to its extremities at opposite sides of the valley. May we hope, sir, that these prudential measures will always obtain in the future, and that we have heard the last of the appalling catastrophies due to failures of such structures.

CHAS. BAILLAIRGE, C.E.

Quebec, December 19, 1898.

ANGLE INDICATOR.



(FAY'S PATENT).

This tool is what its name implies. It is to be used in connection with a universal bevel for transferring any given angles. It will produce a given degree as accurately as any micrometer protractor, but not the minutes. It is nicely graduated from 0 to 90 deg., reading from both ends, and it is finished in the Stevens Arms & Tool Co.'s usual superior manner. We cannot emphasize too strongly its great usefulness. It is stated that it should be in the hands of every machinist, tool-maker, draughtsman and metal sheet worker, in fact, any person who desires a handy angle indicator.

CONCRETE RAILWAY STRUCTURES.*

BY F. G. JONAH, M. CAN. SOC., C.E.

That concrete possesses many great advantages in the construction of railway structures is being more generally appreciated from year to year, and with the increasing interest in this class of work the writer feels warranted in presenting to the members of this society some designs of concrete culverts and bridge piers. These structures are particularly well adapted for use in the construction of new lines of railway, owing to the comparative ease with which the material for making concrete can be transported, as against heavy stone-work The use of derricks for loading and unloading material and specially constructed wagons for heavy hauling are not necessary in concrete work, and, as it can be made with cheap, unskilled labor, a great saving in the wages of the force employed is thus effected. These culverts have a decided advantage over cast iron pipes on new works, owing to the great cost of transporting the pipe, but for renewals on old roads, cast iron pipe, up to five feet in diameter, is excellent. They will be much safer from washouts, however, if the ends are protected by wings, for which nothing is better than the concrete ends shown on the culvert plans. The plans submitted ranged in size from an 8 inch sewer pipe, with concrete ends, up to a five foot arch culvert. In 1894 the writer built upwards of thirty culverts after these plans, and up to the present time there has not been a failure of any kind about them.

The arches were turned with hard brick; in a larger culvert they could be made entirely of concrete, but for a small semi-circular arch there would be difficulty in holding the fresh concrete in place. In the construction of these culverts, wooden forms are necessary for the work above the bottom or pavement line. The forms are practically moulds into which the concrete is dumped. They should be made of lumber not less than 1½ inch thick, dressed on the side next to the concrete. They should be well made and held together with clamps, to facilitate putting up and taking apart rapidly. If carefully used, one set of forms will serve for a great many culverts. For that portion of the culvert which is in the ground, including the back of side walls, the earth should be carefully excavated to the exact form of the culvert, any irregularities or holes beyond the figured dimensions will represent a waste of concrete. In putting the concrete in place, great care must be exercised in tamping it thoroughly, to insure a close contact with the forms. If this is not done, the work will present a honeycomb appearance when the forms are removed. Forms should be left standing in place until the concrete has partially set. It was found in this work that to make one cubic yard of concrete required 1.17 barrels Portland cement, 24.5 cubic feet of broken stone and 9.3 cubic feet of sand. To make a cubic yard of brickwork required 400 ordinary size brick and .93 barrels natural cement. The material was hauled an average distance of three miles, and cost on cars as follows:

Portland cement, per bbl.	$2 90
Louisville cement, per bbl.	90
Machine crushed macadam, per cubic yard.	2 10
Sand per cubic yard.	80
Brick, per M.	8 00
The following rate of wages was paid:	Per day.
Teamster, man and team.	$2 50
Bricklayers	2 50
Concrete gang:	
Foreman	2 00
One laborer	1 50
Six laborers at.	1 25
The average cost on all culverts was:	
Earth excavation in foundations.	$ 35
Concrete per cubic yard.	6 80
Brick-work per cubic yard.	7 70

*From a paper read before the Canadian Society of Civil Engineers

TORONTO WATER WORKS CONDUIT.

The first or north section is that across the harbor from the pumping station to Hanlan's crib. It consists of two pipes nearly parallel, the westerly pipe 3 feet in diameter, of cast iron, with each joint flexible, laid in 1874; the easterly pipe of steel, 4 feet in diameter, laid in 1889 and 1890; the length of this section is 4,660 feet. The second or central section is that through Blockhouse Bay and across the Island from Hanlan's crib to the shore crib. It consists of two parallel pipes, the south-westerly one of wood, 4 feet in diameter, laid in 1873, 1874, 1875 and 1876, but abandoned on the completion of the second pipe, which was laid in 1889 and 1890. The northwesterly and new conduit is of steel, 5 feet in diameter. The length of this section is 6,027 feet. The third or south section is that in Lake Ontario, from the shore crib to the intake. A wooden pipe 6 feet in diameter for a distance of 2,357 feet, laid in 1881 and 1882. This section was extended a distance of 365 feet in 1890 and 1891. This extension is of steel 6 feet in diameter, making the total length of this section 2,722 feet. The manholes are of iron, with a trap-door at the top of each, not air tight.

(For profile of conduit see City Engineer's Report, 1893, pp. 3 and 4. This shows the depths to top of conduit, the filling over it, the points where pipe broke, etc.).

In the latter part of 1893, after the conduit had been fully repaired, the friction head was measured and found as follows: "While by D'Arcy's formula the head consumed on the 6-foot pipe was sufficient to deliver 32,000,000, on the 5-foot pipe 28,000,000, and on the 4 and 3 foot pipes, 29,000,000 per 24 hours, or expressing it in friction head, the total measured head was 6.5 feet to deliver 22,500,000, against a calculated head of 3.91 feet, showing a loss of 2.59 feet, the water in the lake being 1 foot 0 inches above zero." (See pp. 31 and 32 City Engineer's Report, 1893). The actual head in each section is given in this Report, but it is evident that the 6-foot section was not carrying the water it should. In examining it since the last accident, sand was found in it to a depth of 2 feet in places. Making an approximate calculation for the obstruction in the 6-foot pipe, and taking a higher coefficient for roughness the theoretical head in each section necessary to deliver 22,500,000 of gallons per 24 hours would be as follows:

	Head.
North Section—4 foot and 3 foot pipes combined, 4,660 feet long	3.00 feet.
Central Section—5 feet diameter, 6,027 feet long.	2.65 feet.
South Section—6 feet diameter, 2,722½ feet long.	0.85 feet.
Actual head.	6.50 feet.

With the lake 18 inches below zero it will be found that the hydraulic grade line when delivering 22,500,000 gallons at pump well, will touch the top of the 4-foot conduit at one point only, that is, 125 feet north of Hanlan's crib, at which point the conduit rose in 1892, and again in 1895. On the profile of 1893 it is shown as uncovered with sand. In the second section the top of conduit is above the hydraulic grade line for nearly half its length, at one point being half the diameter of the pipe

above it. At this point the conduit rose in 1892, also at the second highest point in this section.

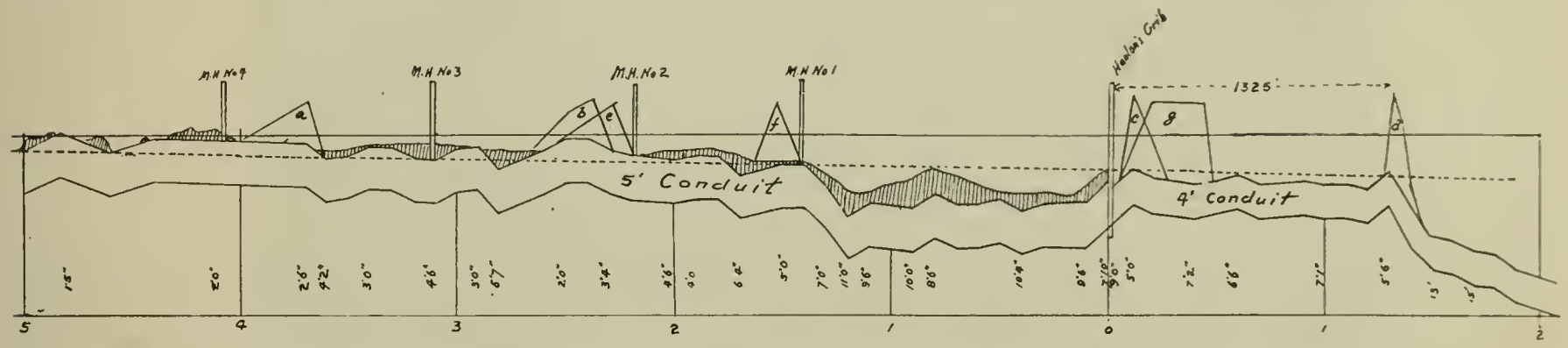
To test the filtering capacity of the basin on the Island, pumping through the 4-foot wooden conduit was commenced on November 25, 1875, and continued until December 7, 1875, when portions of this pipe came to the surface. This rising was doubtless due to lack of sufficient covering above the pipe. The contractors when the accident occurred claimed that it had been covered as specified, and attempted to prove that the specified covering was insufficient. The elevation of the lake was about 5 inches below harbor zero when the rising occurred. The contractors, however, paid the cost of re-laying and re-covering the portions that rose. This pipe was abandoned in 1890 on the completion of the parallel steel conduit, 5 feet in diameter.

On December 25th, 1892, the steel pipes suddenly rose at two points in the first section, near Hanlan's crib, and at two points in the second section. At this time the lake elevation was about 18 inches below harbor zero.

(For description, see City Engineer's Report, 1893, pp. 5, 6 and 35 to 53; also W.W. Superintendent's Report, 1892, p. 9; for capacity of conduits, see City Engineer's Report, 1893, pp. 31 and 32).

regarded as an "accident," caused directly by the pump-house engineer not following his instructions to stop the machinery if the pump well lowered beyond a certain point. A float in the well could have been connected with a throttle valve, thus automatically stopping the engines. The pipe rose, however, and it cost $50,000 in money, and three months' time to repair it. If the cause of the rising were fully understood why were not automatic registers placed in the different manholes along the conduit, and at the pump well, to record the fluctuations in friction head? Why was the conduit not covered with sand at all points that were above the hydraulic grade line, loaded with stone filled cribs, or anchored down with piles? Why, if the department knew the danger of an accident occurring, were not daily inspections made of the conduit after it was repaired in 1893? One inspector could have examined the conduit daily at each manhole along its course, noted the velocity, the elevation of the water, and could have thus detected any evidence of foul play or symptoms of an accident?

Official reports were made to the city council warning that body of the danger in not having a more perfect conduit, yet no steps were taken to lower the high points to grade, to load it, or to even guard it by patrolling. It was claimed that it was leaky, that large quantities of sand had found entrance to it,



PROFILE SHOWING PART OF THE TORONTO WATERWORKS CONDUIT, MARCH, 1893.

The pipe rose at points "a," "b," "c" and "d," in 1892, and at points "e," "f" and "g," in 1895. The upper horizontal line is 18 inches below "zero level" of the lake, and the dotted line is the approximate hydraulic grade line. The vertical numbers give the depth to the top of pipe below "zero level" of the lake, and the shading slum the covering of sand over the conduit.

On the morning of September 5th, 1895, the conduit rose in the first section at the same point as one of the breaks in 1892, also at two points in the second section. The lake at this time stood at 9 inches below zero. (For description, see City Engineer's Report, 1895, p. 68).

From 1888 to 1893 there was no experienced civil or hydraulic engineer at the head of the waterworks department of the city of Toronto. During this period the city spent about $200,000 on these conduits, which were designed and constructed under the department staff. After the rising of the conduit in December, 1892, the waterworks department was re-constructed, and on January 30th, 1893, the works were placed under the direct supervision of the city engineer.

The large amount paid for engineering and engineering advice in 1895 was simply the arrearage due the engineering profession.

The accident to the wooden conduit of 1875 was doubtless caused by an insufficiency of filling over it. The contractors had notified the city engineer that this work was completed, but the engineer had not satisfied himself of the correctness of their statement. The contractors endeavored to prove that the covering specified was not sufficient, and claimed upon engineering advice, that if the water were drawn down to a depth of seven inches below the top of the pipe the upward pressure of air on inner surface exposed would more than equal the weight of 2½ feet of sand above it. After the pipe was re-laid and the re-filling completed, the water was drawn down much more than the seven inches, but the pipe did not rise. The contractors then acknowledged that their expert's demonstration was incorrect, and that the uprising was due to insufficient filling. The uprising of Christmas Day, 1892, was a surprise to everyone. In the report of the waterworks superintendent for 1892, p. 9, will be found a very brief statement as to the cause of this rising. A quantity of weeds was found at a screen that had been temporarily placed in the shore crib, where the 6-foot wooden conduit connected with the 5-foot steel pipe. The examination and tests then made to determine the cause were of a very superficial character, and it is now more than doubtful if the official reasons were the correct ones. It was apparently and that it was in danger of being broken at any time by vessels. The experiment made in 1894 (see report for that year, p. 99), demonstrated that the conduit across the harbor was practically water tight. Neither bay water or sand could therefore enter this section. In the second section the surrounding water is much better in quality than in the harbor, and the pipe is partially bedded, and in places covered with sand. The official reports withhold all information respecting the actual leakage into this section. The leakage in the lake section would be trifling owing to the low head, and the water entering it would be of comparatively good quality. Until proven to the contrary it may be claimed that the conduit in 1894 and in 1895 to September 5th was not leaking, and that no sand was entering it.

In repairing the breaks in 1893 and in 1895 large quantities of sand were found in the conduits in the vicinity of the breaks, but there is no reason for assuming that this sand was there before the pipes rose, but every reason for believing that it entered at the time of the upheaval. The danger from the vessels was slight, and could have been practically eliminated by proper buoying and marking of the line of conduit. The rising of the conduit on September 5th, 1895, in exactly the same way as on December 25th, 1892, was doubtless a shock to the waterworks department. The following is the alleged combination of circumstances that caused the "accident." (City Engineer's Report, 1895, p. 69):

First.—Enormous accumulations of sand in the conduit

Second.—The unprecedented low state of the water in Lake Ontario.

Third.—By a vertical plank obstruction found in the lake shore manhole.

Suggestions of foul play were circulated at the time of the accident, but they do not appear in the official report. An explosion of dynamite would have caused effects that could not have been overlooked. This charge against unknown malicious parties was soon dropped, but the search for the point where the dynamite was applied disclosed the fact to the public that the conduit had not been properly or regularly inspected.

A piece of planking about 16 inches wide, 3 inches thick

and 8½ feet long was found in a vertical position in a manhole near the lake, in the 6-foot conduit, the lower end being imbedded in sand. The newspapers at the time reported that the engineers had stated that this was doubtless the cause of the accident, but it was then assumed that the reporters had manufactured the item, in their sanguine efforts to fathom the mystery. We find the statement repeated on page 69 of the City Engineer's Report for 1895. The capacity of the 6-foot conduit is there stated as being reduced 40 per cent. by the plank and the sand. The depth of sand is not given in the text, but the newspaper at the time gave it as 18 inches at this point, which agrees with the depth shown on the profile of the conduit given in the Engineer's Report. How much of this 40 per cent. was due to the sand and how much to the plank ?

The sand accumulations would be gradual, and examinations after the uprisings showed that they were chiefly in the 6-foot conduit, and in the vicinity of the broken joints. The average depth of sand in the 6-foot conduit was probably 18 inches. (See page 88, City Engineer's Report, 1895, also profile, page 68). At the time of the rising the water stood at 13½ inches below zero, and a few inches higher than in December, 1892. A glance at the chart of the lake elevations during the preceding forty years would have shown that the elevation in September, 1895, was not "unprecedented," as it had been lower than this in no less than four different years. The lower the water the lower the hydraulic grade line, and therefore the greater the risk of rising. Gaugings of the lake are taken several times per day, and the engineer at the pump-house keeps a record of the level of the water in the pump-well. It cannot be claimed, therefore, that the department was not aware of the low stage of the water, yet the conduit was not kept from rising. It had been reported against and condemned, yet little had been done towards making it safe as the lake lowered. If, therefore, low water were the cause, it could not have been fully appreciated by the department.

It is a well-known fact that all surface waters contain small particles of air, without which it is claimed fish would die, and possibly all subaqueous animal life cease to exist. In laying conduit pipes on land engineers place at all apices, air valves to permit the escape of air that collects at such points. These valves may be automatic. Small pipes carried from each apex to a point above the hydraulic grade line serve the same purpose. Referring to the profile of the conduit immediately north of Hanlan's crib there are two points or apices that touch or pass the hydraulic grade line. It is evident that air would gradually accumulate at these points. The conduit has risen twice at one of these points and once at the other. If it be granted that air accumulated so as to fill more than one-third of the volume of the pipe at one point, then it is easy to show that the pipe would rise. The 4-foot conduit was laid in lengths of 57 feet, of Scotch steel plates, ⅜-inches thick, each length weighing about 12,000 lbs. (See Report, 1890, p. 18). This gives a weight per lineal foot of pipe of 210 lbs. The water contained in one lineal foot of this pipe weighs 785 lbs. If, therefore, one-third of this water becomes replaced with air the pipe must rise, unless loaded. The 5-foot pipe weighs 300 lbs. per lineal foot, and the contained water 1,230 lbs. In this case a removal of one-fourth of the water would jeopardize the pipes' stability. Every engineer who has had experience in testing waterworks distribution systems, pumping engines and long conduits, knows that the theoretical pressures are frequently increased enormously by what appear to be comparatively small changes in conditions, caused by the inertia of the moving mass of water. If there be air in the pipes, these fluctuations will be aggravated.

Now, is not this what occurred at each of the two risings of the steel conduit: First, the conduit was above the hydraulic grade line at some points, and close to it for a great distance. Second, air had accumulated at many apices. Third, fluctuations in the head caused variations of pressure on the air pockets. Fourth, a bubble of air escaped from one or more of the high points, ran to a higher point, and caused a disturbance in the water, a surging backward and forward. Fifth, this surging of the water produced alternate compression and expansion of the air, at one of which expansions the pipe rose, the water hammer contributing to loosen the pipe from its bed. Sixth, by rising at one point a violent commotion was instantly set up at other points where air had accumulated, and the conduit rose at several such points.

If there were a leaky point at an apex it is possible that the air might have escaped. This in reply to the query: "Why did not pipes rise at all high points ?" In 1893 the conduit was replaced and repaired, but the cause of the rising was certainly not understood, or if so not made public. By carrying small pipes from the principal apices to a few feet above high water level, the air can be removed and the full capacity of the pipe utilized, to the hydraulic grade. The sand deposited over the conduit would tend to improve the character of any water that might leak into it. It was officially announced in 1892 and 1893, that the first uprising was caused by the clogging of a screen at the shore crib with weeds. This was generally believed at the time, but since the second accident when nothing of the kind was discovered, the thinking public became skeptical as to the correctness of the reason given in 1892-3. The conduit was in continuous use nineteen months before the accident of 25th December 1892, and about thirty months after the repairs following this rise. The greater length of the second period may be accounted for by the higher lake level in 1893, the strengthening of the weakest high points, and the gradual silting up of the channel in which the conduit was laid. Loading the pipe by sand, by cribs, or by driving piles and bolting cross-timbers above the pipe, will prevent an uprising, but cannot prevent the accumulation of air, and a reduction in the capacity of the conduit.

BOATS OF THE DOMINION TYPE

Editor CANADIAN ENGINEER :

It is remarkable how often minds in diverse positions will run in nearly parallel lines on some subject. Your November article upon the latest defender of the Seawanhaka Cup recalls an idea I developed in 1894 for what I termed "hollow-keeled boats," consisting of a fine lined shell, barely enough to float the crew, while over it was superimposed a wide shallow hull, with easy lines, of which the former would represent a hollow-keel. Say a boat 15 feet long, 4 feet wide, 10 inches deep, with a shell keel 12 feet long, 12 inches beam, and 4 to 5 inches deep, will float one man with feet in the run aft, seat on the floor of the larger boat, and centre of gravity lowered the amount of depth of keel. This gives extra depth for stepping mast, centreboard, rudder, etc., while leaving a very light buoyant skiff on the top of the water. If the keel be made detachable, one skiff may have a flat keel for duck hunting and shallow streams: another for rowing and paddling of light draft; while for sailing, a sharp, deep, heavy keel and centreboard will be most satisfactory, giving virtually three boats in one. I built one eight feet long, which runs very well for its size; and I intend trying one with detachable keels, when time permits. I have tried double keels, but find that in a head sea they are apt to fill between hulls and deaden headway. For small motors the hollow keel gives deeper immersion of the propeller, and lower centre of gravity, than in the canoe model of craft. Probably some of your nautical readers may improve upon the above suggestions.

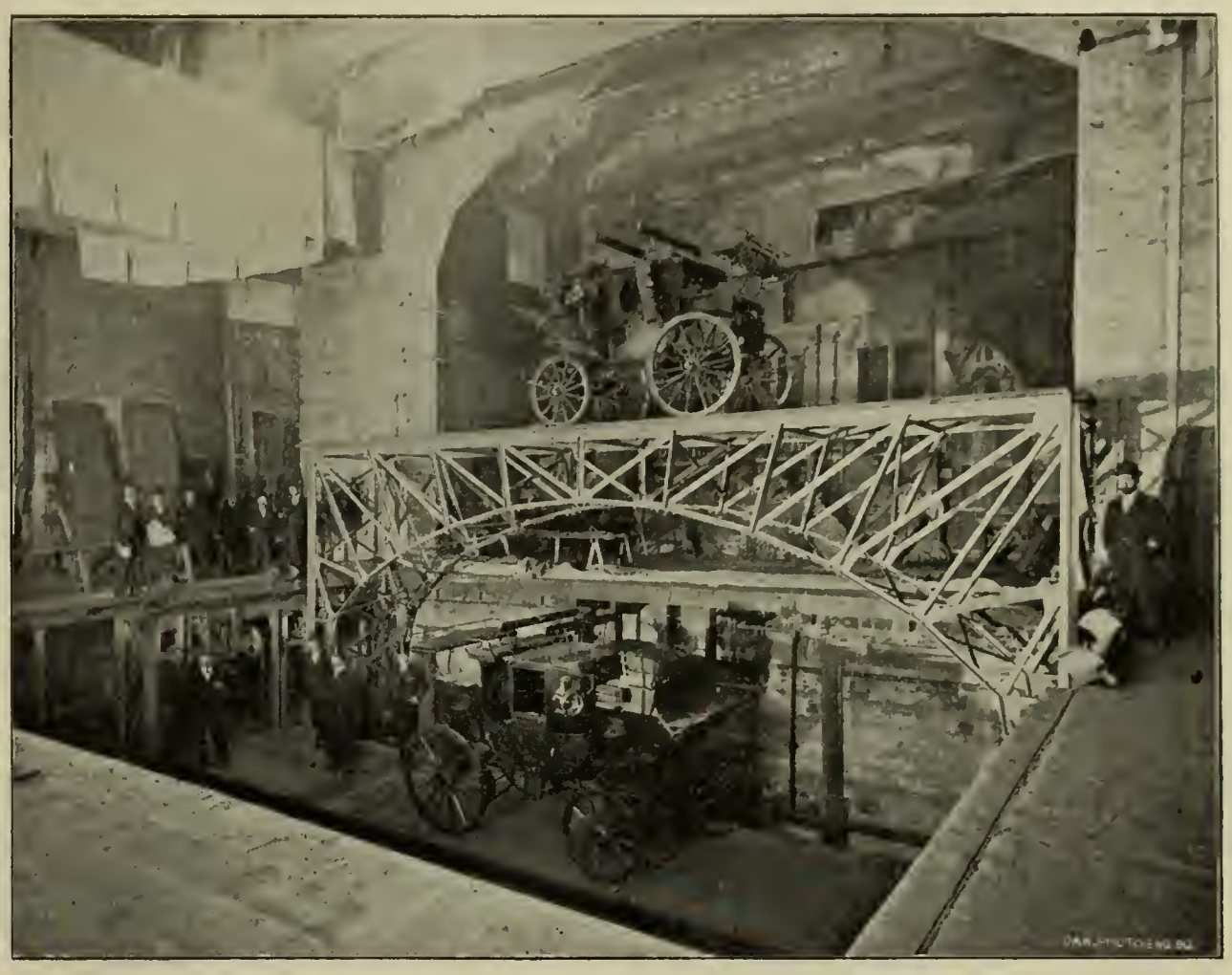
THOMAS FROOD.

ELECTRICAL STAGE APPLIANCES.

(Correspondence Canadian Engineer).

The proposed application of electrical power for mounting plays in the Drury Lane theatre, London, on the lines advocated by Edwin O. Sachs, architect, has taken a tangible form in the completion of the first section of the stage installation in time for the season's pantomime. Mr. Sachs' present work refers principally to the stage floor, and its movability in sections above and below the footlights. The total area now already movable by mechanical power exceeds 1,200 square feet. The electrical appliances just completed take the form of so-called "bridges," each working independently. Each individual section measures 40 feet by 7 feet, and weighs about six tons, of which about four tons are counterbalanced. They can travel about 20 feet vertically. The motive power is from the ordinary electric supply mains over a four-pole motor, developing 7½ h.p. at 520 revolutions per minute. The "bridges" are suspended from cables, and these, working over the motor allow the former to be raised with the necessary live load at rates

varying from 6 feet to 20 feet per minute. Every possible safeguard is provided against accident, the "bridges" themselves being so constructed that in the event of derangement of current the appliances can be worked by hand gear. Automatic switches are provided so as not to be entirely dependent on the attendants, and automatic catches will work in case of rope-breaking. Special locking gear has been installed to hold the



THE STAGE, DRURY LANE THEATRE, LONDON—ELECTRICALLY OPERATED.

"bridges" stationary at certain points, such as stage level, and a very large factor of safety has been allowed in apportioning the strengths and weights in the various parts of the mechanism, having special regard to the ever-increasing scenic requirements. As regards the economic aspect of the electrical installation the initial outlay on Mr. Sachs' system is about half that of continental hydraulic work, and this is allowing for English contractors as against foreigners. The maintenance is minimal, whilst the actual working only costs a few pence per performance. The saving in manual labor on the stage is very considerable, whilst the hygiene of the theatre is materially raised by the absence of woodwork. For the successful execution of this work Mr. Sachs is primarily indebted to the enthusiastic encouragement of Arthur Collins, who is the first manager to introduce modern methods on the stage, and deserves the congratulations of the technical professions. He has been ably seconded by the Thames Iron Works, their engineers, Messrs. Stewart & Grove, having to meet innumerable difficulties, as most of the work was carried on at odd moments or at night during the run of the "Great Ruby."

THE STEAM BOILER AND ITS SAFETY.*

The modern demand for high-pressure engines is fostering sectional and water-tube boilers. The more rapid adoption of such boilers is retarded on account of so many of their parts being made of cast iron, together with so many joints and connections. These are objected to by the old-type manufacturers, and those unwilling to accept something new. Nevertheless the external horizontal tubular boiler will soon be out of the modern class as a steam generator. It is limited in the thickness of sheet, therefore, in its diameter. Consequently on account of its being externally fired, its pressure and power is limited. This alone has turned the attention of boiler manufacturers to a more perfect arrangement for stationary, as well as marine purposes.

At the present day, the choice is for high pressure in stationary boilers, embracing several designs of water tube and internally fired boilers of different type. From an economical standpoint there is little difference, notwithstanding the claims and reports of efficiency tests advanced by the makers of the different designs. On the other hand the safe working pressure of the boiler, we are compelled to take the maker's figures as there is no law in this province formulating the proper rules, founded on mechanical principles, to determine the safe working pressure of the steam boiler. An instance of the above occurred to me quite recently when called upon to inspect a horizontal, tubular, externally fired boiler. The dimensions of the boiler were 72 inches diameter and 16 feet long. The plates of steel ⅜-inch thick with a tensile strength of 60,000 lbs. per square inch. There were 114 3-inch tubes, and the heads were of flange steel ½-inch thick. The longitudinal joints were double riveted: the rivets being ¾-inch in diameter, and the pitch 3 inches, and it is fair to suppose the holes at 13-16 inches. The efficiency of the joint so far as net sections of plate is concerned is 3-in.—8125÷3 in.=72.9%. The area of a 13-16-inch hole being 0.5185 square inches, the single shearing strength of one rivet is .5185x38,000=19,700 lbs., and as there are two rivets in a unit section of the joint (the joint being double riveted), the total shearing strength of the rivets in a unit section is 39,400 pounds. The strength of a strip of the solid plate, 3 in. wide, being 3x⅜x60,000 lbs., equal to 67,500 lbs. Then for the efficiency of the joint so far as rivet area is concerned is 39,400 divided by 67,500=58.4%. This is much less than the efficiency of the net section, therefore it follows that the joint is badly proportioned. The rivet area is too small; notwithstanding this the builders had no hesitation in recommending this boiler for a safe working pressure of 100 lbs. per square inch. Whereas with a factor of safety of 5 the safe working pressure on it is 73 lbs. per square inch. The safety valve was set at 100 lbs. per square inch, and the owners of this boiler congratulated themselves on their new steel boiler. Really the boiler was no stronger with the 60,000 lbs. steel than it would have been with 50,000 iron. Now a proper double riveted lap joint for this boiler would be diameter of rivet ⅞-inch, pitch 3 7-16-inch. Efficiency of joint 69.4%. This would give a safe working pressure (with a factor of 5) of 87 lbs. per square inch. Many years ago Sir William Fairbairn stated the efficiency of a single riveted joint to be 56 per cent., and that of a double riveted joint to be 70 per cent. No doubt he meant it to be understood that this was the limit practically obtainable with careful design and construction, and I am sorry to say that it is a common practice among engineers who should know better, to allow 56 and 70 per cent for single and double riveted joints respectively, without the least regard to the actual proportions of the joint.

*A paper read before Hamilton Branch, C. A. S. E. by F. G. Mitchell, London

Another case which came under my observation not long ago, was a horizontal tubular boiler, externally fired, 48 inches diameter and 12 feet long, the plates were of steel 60,000 lbs. tensile strength, 5-16 inches thick and single riveted. The diameter of the rivets was ⅝ inches and the pitch 1¾ inches. the heads ⅜ inches thick. The workmanship of this boiler was excellent in every respect, and I believe the material was also. The only objectionable point about the boiler was the riveted joint. The diameter of the rivets being ⅝-inch we will suppose the holes to be 11-16-inch or 0.6875. The pitch being 1.75, the efficiency of the joint so far as the net section of the plate is concerned is $\frac{1.75\text{-inch}-0.6875}{1.75}=60.7\%$. The area of a 11-16-inch hole being 0.3712 square inches, the strength of one rivet (assuming the shearing strength of rivet iron were to be 38,000 lbs. per square inch), is .3712x38,000=14,100 lbs., and the strength of a strip of the solid plate 1.75 inches wide, being 1.75x5-16 inches x 60,000=32,800 lbs. We find that the efficiency of the joint so far as rivet section is concerned is 14,000 divided by 32,800=43%, whereas if properly designed it should be 56%. Now, why is it that an otherwise good boiler manufacturer will allow construction such as this? He might as easily and without any more expense, have turned out a much better and safer boiler. It may be possible that the templets used had been arranged for 40,000 or 45,000 lbs. per square inch iron. This does not explain the whole thing, for now-a-days the manufacturer will go even a step closer by using only a factor of 4 with practically the same externally fired boiler.

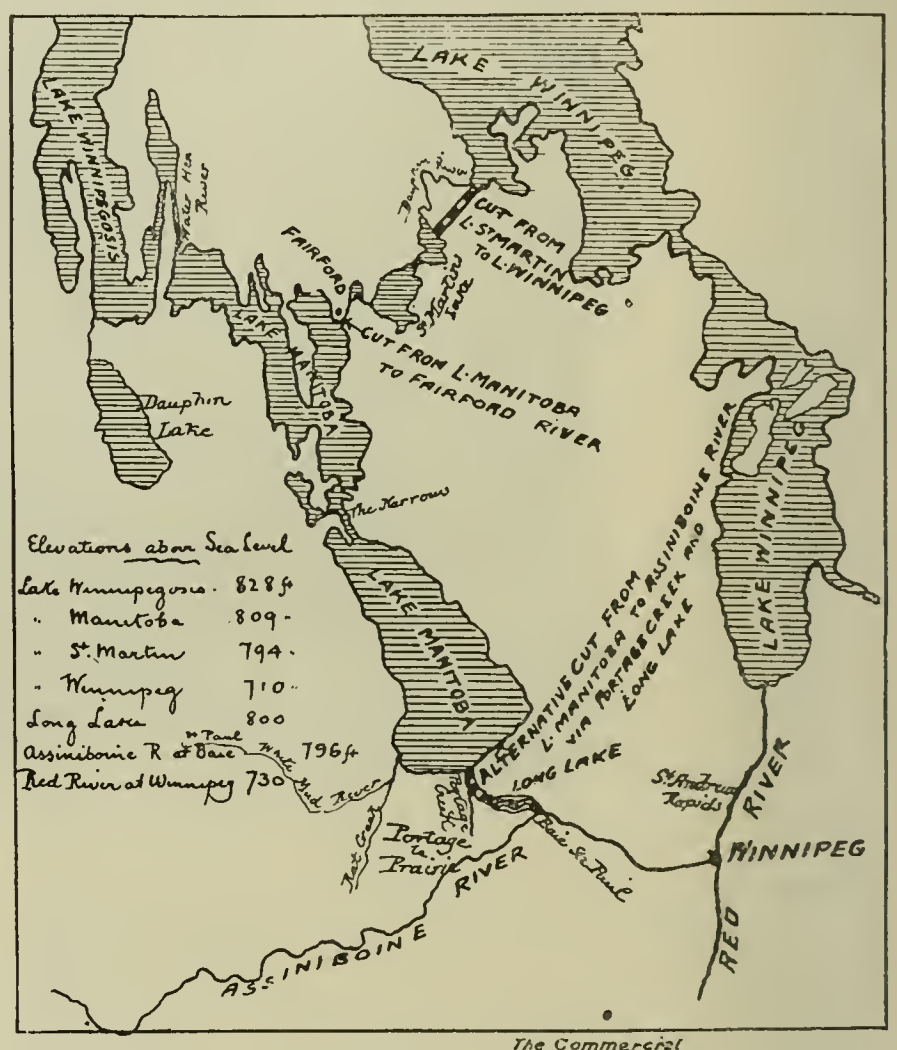
There are many defects that are likely to be found about a steam boiler and the ones most common are corrosion and grooving along the girth seams, generally on the bottom sheets and cracks extending from the edge of the sheet to the rivet holes. On the outside landing, this is more often found where heavy plates are used. The most serious form of corrosion is that which attacks the plates along the water level, forming a continuous line of weakness. This is, of course, due to the acids in the feed water, and can only be remedied by improving the supply. External grooving is often due to leaky calking and is very often caused by the use of what is known as a split calking tool having broke the skin of the metal. Buckled or boged sheets usually result from neglect in keeping the boiler clean. Soft deposits are allowed to accumulate over the fire and become hard, allowing the plates to become over-heated and be pushed down with the pressure. In iron boilers this has been attended by ruptures, while in steel boilers the buckled part grooves thinner at its lowest point until a small hole causes a leak.

I wish to mention before closing, a very important consideration about the steam boiler, and that is, the so-called mountings. How many boilers do we meet with that have a perfect working safety valve, one that will permit the escape of steam as fast as the boiler will generate it, and not allow the pressure to exceed at least 10 lbs. above what it was set for. Anything else is only an excuse for a safety valve. It is also quite a common thing to see water columns connected to the boiler with ½-inch and ⅜-inch pipe, and with three and four bends in it, and a small pet cock at the bottom to blow it out. This is another excuse. Also how often do we see a common plug cock put on for a bottom blow off. There are no mountings or fittings too good for a boiler, and none other should be used nor allowed to be used.

THE LAKE MANITOBA CANAL.

The question of lowering or controlling the water level of Lake Manitoba has been agitated for a number of years. The volume of water running into Lake Manitoba is considerably greater than the outlet capacity. A number of rivers and creeks flow into the lake, while its only outlet is the Fairford river to Lake St. Martin and thence via the Dauphin river to Lake Winnipeg. An important matter to be taken into consideration in connection with the lowering of the lake is its value as a navigable body of water. Some persons who have made a study of the question, claim that the lake is of greater value for purposes of navigation than the flooded land in its vicinity. The Winnipeg Commercial recently discusses the matter at some length, and we reproduce the accompanying illustration from its pages. Lake Manitoba is quite shallow, and if the water is materially lowered it will destroy navigation on the lake.

As early as 1881 the late Thos. Guerin, one of the most able hydraulic engineers in the employ of the Dominion Government, made an extended examination of the lake, with the object of discovering what could be done to reclaim the flooded lands and prevent a recurrence of the trouble. Mr. Guerin made a very full report as to the result of his work. He recommended that the outlet be enlarged by cutting a channel about two miles long, from the lake to the Fairford river, below the rapids on that stream. This would increase the outflow to Lake



LAKE MANITOBA CANAL.

St. Martin. In order to provide for the carrying off of this increased inflow to Lake St. Martin, he also provided that another cut should be made from the latter lake to Lake Winnipeg, otherwise the country about Lake St. Martin would be flooded. Mr. Guerin found that 14,833 cubic feet per second of water was being discharged by the Fairford river into Lake St. Martin, while the outlet from the latter lake to Lake Winnipeg, via the Dauphin, or Little Saskatchewan river as it is sometimes called, is only 12,486 cubic feet per second. The land around Lake St. Martin, which is quite as valuable as the flooded territory around Lake Manitoba, was therefore also subject to flooding. To increase the outflow into Lake St. Martin without providing for an additional or larger outlet into Lake Winnipeg, would simply result in flooding the country around Lake St. Martin. Mr. Guerin estimated the cost of the short cut from Lake Manitoba to the Fairford river at $36,000, while the cost of the cut from Lake St. Martin to Lake Winnipeg he placed at $245,000, or a total cost of $281,000 to reclaim the 200,000 acres of flooded land around the lake.

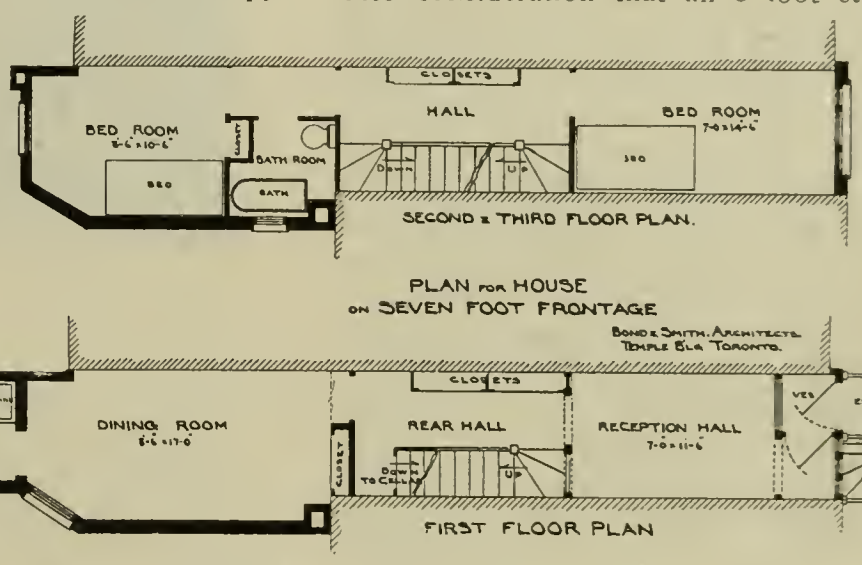
The Dominion Government, it now appears, has decided to go ahead and make the first short cut, without providing for the vastly more costly cut which it will be necessary to make to prevent the flooding of land around Lake St. Martin.

It seems to be agreed that Lake Manitoba might cheaply be part of a system of communication between the Red and North Saskatchewan rivers. The securing of navigation between Winnipeg and Edmonton via Lake Winnipeg is a matter of the utmost importance to the farmers of the Northwest. It is not necessary to abandon these lands in order to preserve the navigable value of Lake Manitoba. By the cutting of a canal from the southern end of Lake Manitoba to the Assiniboine river, the level of the lake can be reduced or regulated, and the

flooding of lands in the Lake St. Martin region would be prevented. It would give such a flow of water as would greatly assist in rendering the Assiniboine river navigable between Winnipeg and Portage la Prairie; it would also improve navigation on the Red River between Winnipeg and Selkirk. It would give a sufficient flow of water to render it possible, The Commercial states, to develop a minimum of 15,000 horse-power on the Assiniboine river at Winnipeg. From Lake Manitoba to the Assiniboine river the distance across from the lake to the Assiniboine at Baie St. Paul is about seventeen miles. The fall is about fourteen feet. Long Lake forms a natural canal for about one-third of the distance, and Portage creek also forms a natural canal for a considerable distance from Lake Manitoba toward the Assiniboine river. The sketch map shows the Lake Manitoba basin with the outlet of the lake via Fairford and Dauphin river to Lake Winnipeg, also showing where the proposed cuts are located, whereby it is intended to lower the level of the lake. As noted, the intention is to make only the first short cut at Fairford now. This map also shows the alternative cut to the Assiniboine river, by which the level of the lake could be controlled as readily as by the two cuts at Lake St. Martin.

A VERY SMALL HOUSE.

This engraving shows plans prepared by Bond & Smith, architects, Temple Building, Toronto, for a house to occupy the narrow strip of land left in a city terrace to serve as a lane but no longer needed for that purpose. It will probably be the smallest modern house ever built in Canada.



PLAN FOR HOUSE
ON SEVEN FOOT FRONTAGE
BOND & SMITH, ARCHITECTS
TEMPLE BLK TORONTO.

A VERY SMALL HOUSE.

WIND MILLS AND PIPES.

BY WILLIAM PERRY, MONTREAL.

During the past few years considerable attention has been given to pumping machinery in its various details; and personally I have given it much time so as to derive from it information on a practical basis. Nothing is more generally disregarded in erecting a pumping outfit than the proper size of pipe, and the proper size of cylinder to be used with a particular size of pipe. Men, who for a number of years have had the old style wooden wind-mill running slowly, with pump larger than can be used on a modern steel wind-mill, do not realize that the pump for a modern fast running wind-mill, with a stroke twice as long, must have a reduced diameter of the cylinder, and a larger discharge pipe to carry off the greater quantity of water. With the old wooden wind-mill, which has 5 or 6 inch stroke, inch or three-quarter inch pipe has been used for the discharge without bad results; because the wheel has not had power to injure itself. You could hitch it to the pump rod, and it will stand like an old horse. I frequently have correspondence on the subject as follows: "I have been using my mill on one inch pipe with a 3-inch cylinder and 5-inch stroke for years, and do not see why I should change it to put in a fast running steel wind-mill. It did the work before the old mill wore out." It is quite the general belief that it is easier to elevate water 50 or 100 feet through one inch pipe than through 1½-inch pipe. The fact is not taken into consideration that while the weight of water in the 1½-inch pipe is 2¼ times as great as in the 1-inch pipe, still the water in the 1-inch pipe must be raised 2¼ times as fast, and by the increased speed there is more than six times as much friction.

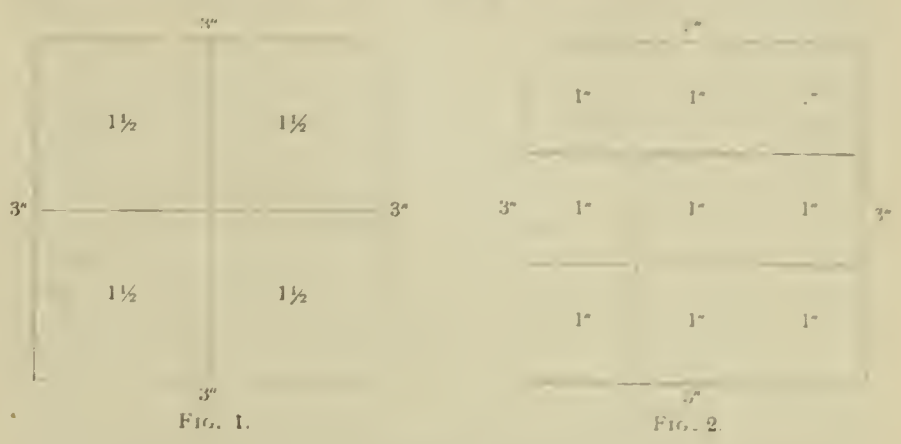


FIG. 1. FIG. 2.

For the purpose of illustration, take a square cylinder and pipe, instead of round, the larger squares in the diagram representing the cylinder, and the proportions are between a 3-inch cylinder and 1½-inch pipe, as shown in Fig. 1, the area being four times the area of the pipe. Fig. 2 shows the proportion between a 3-inch cylinder and 1-inch pipe, the cylinder having nine times the area of the pipe. The same proportion exists between the cylinder and pipe of the usual form having corresponding diameters. As a consequence where 1-inch pipe is used with a 3-inch cylinder the water must rise in the pipe nine times as fast as it rises in the cylinder. When it is taken into consideration that an 8 foot steel wind-mill with 8-inch stroke at its maximum speed will travel 48 feet per minute, or on the down stroke 24 feet, it is plain that with a 3-inch single acting cylinder, with 8-inch stroke, and 1-inch pipe, the water in the pipe must travel 216 feet per minute. Taking into consideration the fact that friction increases according to the square of the velocity it will be seen that it is necessary to reduce the speed as far as possible by using larger pipe.

In comparing the proportionate speed in different sizes of pipe used in connection with 3-inch cylinder with 8-inch stroke, and the proportionate amount of friction in raising water 50 feet vertically with the same cylinder, it must be understood that this proportion is for a direct lift of only 50 feet—in forcing water long distances the friction in small pipes would be very much more. For instance where water is to be forced 2,000 feet horizontally to an elevation of 50 feet, using a 3-inch cylinder with 8-inch stroke and 1-inch discharge pipe, the least possible friction under the most favorable conditions with check valve and straight pipe, and a large air chamber, would require as much power as to raise water with the same cylinder and pipe vertically 193 feet. In actual practice the circumstances could not be found to reduce the friction to so small an amount if no air chamber is used or if it is insufficient, and there are several elbows or short turns in the pipe. The friction will amount to a lift of from 4 to 600 feet; by using 1½-inch pipe under the same conditions, the friction with everything in a satisfactory state would be reduced so that the total power required would equal a vertical head of about 72 feet, which is so reasonable an amount that it would not endanger the safety of the plant. The use of 3-inch pipe under the same conditions would be a barely noticeable change. I have repeatedly had such arguments as follows advanced: "I operate my pump by hand with ease, and it will not work as well with the wind-mill.' This does not necessarily follow in operating by hand. The

stroke is much slower and the power applied not as positive. If the pressure becomes too great the man will work more slowly and will often stop to rest. The wind-mill works right along and the stronger the wind the greater the pressure and the less possibility of checking the speed. Wind as a motive power for driving machinery and pumping water now occupies a large field, and the improvements recently made render the wind-mill more reliable, and in action less liable to damage by storms, as it is self-governing. These mills are used for pumping water, grinding, sawing wood, etc. They are most efficient in exposed situations, but they can be utilized anywhere if placed at an elevation where they can get the full force of the wind. It is necessary to have a storage reservoir capable of holding six or eight days' supply of water when they are relied on as the only source of water supply.

AUTOMOBILE PROGRESS.

The December developments in the matter of mechanical traction have been strikingly sensational. For the first time in the history of the horseless carriage enterprise in the United States the daily papers have had the opportunity of recording genuine transactions on a large scale; and these have been of such a nature as to discount the policy of ridicule which on the part of the English newspapers has retarded the progress of the enterprise in Britain. An American journal recently remarked that the motor carriage problem would find its solution in the United States, the common roads in that country being so atrociously bad that mechanical vehicles that were able to navigate them could go through anything. This is rather rough on the road-makers, though a compliment to the motor makers. Up to date the prediction has not been fulfilled; yet recent photographs of American rigs, run by both gasoline and electricity, show them successfully ploughing through mud, slush and snow during the recent storm in Boston, Chicago and New York, while it is notorious that the automobile cabs in New York stayed out on the streets when cab horses were unable to fight the elements, and street traffic generally was demoralized. The most notable development of the month, because it is undoubtedly genuine, and backed by ample capital, is the purchase of the Fifth avenue stage line in New York. This line has been in the hands of a receiver for some time, its manager being W. G. A. Hemming, formerly of Toronto. The 'busses, about 100 in number, were in a rather dilapidated condition; but under the new management the old equipment and hack horses will be cleared out and electrical omnibuses put on the avenue. There never was such a splendid opportunity for automobiles. Fifth avenue is asphalted for nine miles, has no grades exceeding 10 per cent., is the thoroughfare for the wealthiest New York people, and as The Electrical Engineer remarks, "the line should prove a howling success." The three purchasers of this old Stage Line are millionaires many times over, and represent a wealthy corporation—the Third Avenue Railroad Company—that intends to extend its franchise the entire length of the avenue, thus allowing transfers to the cable road on 125th street, and reaching also the Desbrosses street ferry. There is some talk of the new proprietors installing compressed air; but this is not likely in view of the fact that the company now runs a magnificent electric plant in connection with its street car system, and could thus charge the batteries for the auto-cars at a nominal cost. Prof. Louis Duncan of the Johns Hopkins University, Baltimore, is in conference with the new owners of this Fifth avenue line as to electrical installation. Joseph Leiter, jr., who made such a sensation a few months ago in the Chicago wheat pit, is exploiting compressed air for all it is worth—and a great deal more. He has got control of the foreign patents on the Knight-Hoadley system, and is asking for them the modest sum of $100,000,000. The English journals thus far are poking fun at him in all directions. In New York the compressed air system is reported to be having a boom in the form of "auto-trucks," which are to be run on the streets, and one enterprising journal gives an illustration of the new vehicle, which seems to be a cross between a traction engine and a street car. From the most reliable reports we can gather, the fact appears to be that President Vreeland, of the Metropolitan Traction Company, is going to give compressed air a trial. At present it stands about on a par, for traction purposes, with an enormously heavy battery, but lacking the long series of experiments and the mass of data which are available in connection with its heavy rival. In comparison with hydro-carbon propulsion, compressed air is nowhere, and we predict that it will never get a footing as a tractive power.

The month's news has been enlivened by "scare-heads" in the newspapers giving elaborate accounts of the movements of a lively French Count, named Jotemps, who, it appears, represents a European company that seeks to control the entire output of automobiles. This is a large contract indeed. The United States newspapers, which tell (on the authority of Mons. Jotemps), that the American motor patents are the only ones

NEW OFFICE BUILDING OF THE GRAND TRUNK RAILWAY SYSTEM, MONTREAL.

that are of any value, seem utterly oblivious of the fact that the Frenchmen have the lead of the Americans by some years, are pushing enlargement of their factories at tremendous speed, command unlimited capital, and have legislated a prohibitive duty on all imported motor vehicles. The newspaper report, however, is that the French Count has contracted with all the American auto-car manufacturers for a large number of automobiles per year for ten years, the total amount of his purchases running into fifteen millions of dollars! This is a good piece of news—almost too good to be true, in view of some facts which we happen to know. Here is one: Mr. Jenatzy, with his ordinary electric vehicle, with accumulators weighing 1,800 kilos. (say 4,000 lbs.), developed 28 horse-power in going up a steep hill on a wet day at a speed of nearly 30 kilometers an hour. Per contra: An American electric vehicle with battery weight over 1,400 lbs., going up only 10 per cent. grade, could not develop power sufficient to carry itself up empty, its total weight being only 2,700 lbs., and not an ounce of load except the driver! Yet the makers of this American vehicle claim to have sold the French Count five million dollars' worth of their vehicles. Until we have some corroboration from a reliable source, we must treat the French Count and his exploits as a romance.

In France the motor carriage industry is going rapidly. One firm alone—that of DeDion and Bonton—has orders on hand aggregating $600,000, and others being added daily. Of this total, $125,000 worth are from Germany. The factory is turning out each month a total of $100,000 worth, and enlargement of premises is being made so that 2,000 workmen will be employed, and the monthly output increased to $300,000. In England the London Electrical Cab Co., and the Motor Van and Wagon Co. have made reports to their shareholders, which are to a considerable extent satisfactory, but not indicative of the vivacity which characterizes the French makers. Mr. Pennington, the American inventor, whom The Canadian Engineer has paid some attention in past years, seems to be having the call in England now, orders for 376 of his gasolene motors having been received within the past few months. The report of the British commissioners for light railways shows

quite a boom in electric tramways. Of the 54 applications during November, the motive power of 32 is electricity and 22 steam.

Joseph H. Leiter has secured control of the Rhode Island Locomotive Works, and the company capitalized at $7,000,000; will employ 1,200 hands day and night, and will make 50,000 trucks for New York and Brooklyn at $2,000, and 70,000 for London, whither Mr. Leiter goes in February to arrange for the consignment of output. It has been cabled from Europe that the municipal council of Stuttgart, Bavaria, has passed a law forbidding the use of horses for trucks or heavy freight wagons within the city limits, the automobiles having proven very successful. Even the farmers are interested in them.

PUBLIC OPINION.

Editor CANADIAN ENGINEER :

Sir.—I have received your card of the 19th inst. and have carefully and profitably noted your remarks regarding the elements of nature as well as those of the publishing business. I would add concerning the latter that there is another element quite as important, if not more so than the two you have mentioned—namely, brains, or what is perhaps synonymous with brains—enterprise. During the time I have been a reader of your excellent publication, The Canadian Engineer, I consider that you have furnished this most indispensable element. I, therefore feel it not only a duty but a pleasure to supply you with my portion of that other essential, which you have a right to expect from your subscribers, and accordingly enclose herewith postal note for $1 to renew my subscription for 1899.

Yours truly, F. R. WILFORD.

Iroquois, Ont., Dec. 20th, 1898.

SHERBROOKE GAS AND WATER CO.

The Sherbrooke Gas and Water Co. has recently started up its new water power equipment, and has found it very satisfactory in operation. The new plant was designed to largely augment the company's facilities for supplying electric light and power, there being an increasing business in sight, one contract, for example, being the electrical driving of the machinery in the new shops of the Quebec Central Railway at Newington, when completed. The construction and installation of the water power machinery as a whole was placed in the hands of the Jenckes Machine Co., Sherbrooke, and the finished work reveals an excellent example of progressive ideas and good workmanship. Two 40-in. Crocker turbines in horizontal setting are contained in one steel case, 10 feet in diameter, and over 20 feet in length, and are supplied with water under 31 feet head from the dam some 70 feet away, by two feeder pipes, 80 inches in diameter. Each wheel will develop 518 h.p. The whole wheel case and shafting is supported by steel girders and solid masonry. All bearings are of the self-oiling ring type, and the gate mechanism is operated from a suitable point in the dynamo room overhead. The main driving pulleys located at each end of the wheel case are 108 inches in diameter, 36 inches face. The weight of the entire plant is about 125,000 lbs. Taken altogether, the starting up of this plant marks an important point in Sherbrooke's industrial history, and emphasizes the ability and energy of both of the companies concerned, the one in promptly keeping pace with a growing business, and the other in furnishing the necessary means to this in the shape of an equipment so thoroughly constructed and fully in line with the latest practice.

THE YUKON GOLD DEPOSITS.

The Department of the Interior has received from the Geological Survey a preliminary note on the gold deposits and conditions of mining in the Klondyke region by R. G. McConnell and J. B. Tyrrell of the survey staff. They say that the productive part of the Klondyke gold district as at present known covers an area of 1,000 square miles, and is situated between the Klondyke and Indian River tributaries of the Yukon, and east of the latter river. The approximate area of 1,000 square miles of the known gold fields refers to the district traversed by the gold-bearing creeks, and not to the actual area of pay gravels. The latter are confined to the bottoms of a few of the valleys and the lower slopes of the adjoining ridges, and occupy a much smaller area. The gold occurs in the gravels flooring the bottom of the valleys, in stream terraces lining the lower slopes of the valleys, and in a remarkable moraine or glacial deposit which forms a southern slope of El Dorado and Bonanza Creeks for some miles, and which was also found north of the latter creek for some distance above its junction with El Dorado. The stream gravels have a thickness of two to eight feet, and a width along the most productive portions of El Dorado and Bonanza Creeks of from 100 to 400 feet. They extend across the valley bottoms and increase in width with the gradual enlargement of the latter towards their mouths. The gravels are everywhere more or less auriferous, but the concentration is irregular and the gold increases in quantity towards the bottom of the section. The greater part of the pay is usually found within a foot and a half or two feet of bed rock. A considerable portion of gold is also found in the soft decomposed and shattered country rock, on which the gravels rest, into which it has sunk often to a depth of two feet. The bench gravels are of less importance than the stream gravels, and, so far, are only worked to a considerable extent along Bonanza and along the lower part of El Dorado Creek. The benches only occur at intervals along the sides of the valley, and, as a rule, are rock-cut and not built up by stream deposits. They are found at varying heights, up to an elevation of 75 feet or more above the bottom of the valley. The gravels are mixed with sand and consist of flat and sub-angular pebbles of schist, often a foot or more across, and rounder than quartz pebbles. The gold is fine, but nuggets up to a value of $1.35 are reported to be found. The average yield of the bench gravels is stated to vary from five cents to twenty cents to a pan.

Discussing the probable sources of placer gold, Messrs. McConnell and Tyrrell say that the gold in its original habitat has beyond doubt been associated with quartz, for many masses of gold-bearing quartz have been found and many of the nuggets of gold contain particles of quartz. Whether the gold is chiefly derived from the heavy veins or from the narrow stringers has not yet been determined, but it is probable that in places both are auriferous. They found gold in a thick quartz vein north of El Dorado Creek, but as the abundance or scarcity of placer gold did not appear to depend on the size or number of these heavy veins, it is probable that the precious metal has been chiefly derived from the narrow stringers or leaves of quartz interbedded in the schist. The great ice sheet of the glacial period, which covered much of British Columbia, did not reach as far north as the Klondyke district, so that ever since the land was elevated above the sea, perhaps in the Miocene or Pliocene epoch, it has been cut down by atmospheric and stream agencies into deep valleys and rounded hills, the surfaces of which are covered by varying thicknesses of decomposed rock. There is no doubt that much of this decomposed rock in the Klondyke area contains a small amount of gold, and by constant washing for ages much of this has become concentrated in the beds of the streams. Nor can it be doubted that the work of concentration has been greatly expedited by small local glaciers, which at a period not very remote, have originated at the heads of these creeks and have filled the bottoms of the valleys through part, at least, of their lengths. The higher so-called benches have been formed either as lateral moraines along the sides of the glacier or by streams which flowed between the side of the glacier and the bounding slope of the valley. The great richness of the Klondyke placer ground depends, therefore, first, on the presence of a highly gold-bearing rock, and, secondly, on the occurrence of a set of conditions peculiarly favorable to the concentration of the precious metal.

—Wireless Telegraphy Across Paris is a recent article by Ducretet. He describes experiments in transmitting messages from the Eiffel Tower to the Pantheon, a distance of 2.5 miles: the direct view is interfered with by many aerial structures. The results obtained were perfectly clear, even in a thick fog. The signals could be read by their sound with great ease, or could be recorded, but no results were obtained in endeavoring to transmit in the reverse direction from the Pantheon to the Eiffel Tower, owing to the mass of metal in the latter.

A GREAT WATER POWER CENTRE.

If the 19th century may be called the American age, because it is that of steam, in which our southern neighbors have distinguished themselves, the 20th century bids fair to be styled the Canadian age, because that of cheap electricity, which can only be generated through cheap power. Nothing is cheaper than nature, and this Canada of ours is the most watered portion of the continent. Our attention has lately been drawn to a section of the Dominion which seems to have been richly endowed by nature in the shape of water power. We mean Northern Quebec, where streams of immense volume come down the slopes of the Laurentian mountains. U. Barthe, secretary of the Quebec Bridge Co., has devoted much time to a personal inspection of the larger waterfalls of his district, and has communicated us a summary of the information thus collected, which may interest not only the engineering profession, but also the capitalists of this country, in view of the cheap production of wood, pulp and paper, calcium carbide, and also the use of storage batteries. The city of Quebec itself is surrounded by a remarkable water power system, the principal instances of which are: The Montmorency Falls, the property of, and operated by, the Quebec, Montmorenci & Charlevoix Railway Co., nine miles below the city, minimum power in lowest water with present plant, 5,000 h.p. with a head of 250 feet. They actually run the city electric light and power, the city electric railway, and the two factories of the Montmorenci Cotton Mnfg. Co., and the Riverside Manufacturing Co., and will next summer operate the railway to Ste. Anne de Beaupre, which, with the city system, will make over 60 miles of railway. The Chaudiere Falls, six miles above the city on the south shore; property of the Canadian Electric Light Co., now preparing to develop them; minimum summer capacity estimated at over 5,000 h.p.; head, 110 feet. The Grand Falls of St. Ann, 24 miles below the city, also the property of the Canadian Electric Light Co., estimated to develop regularly about 7,000 h.p.; head, 190 feet. Four or five miles above the Grand Falls, and on the same river, St. Ann, are the beautiful Seven Falls, already mentioned in this paper; total head, over 500 feet. The Valcartier Falls, on the Quebec & Lake St. John Railway, 20 miles northwest from the city; at present in course of development by the Jacques Cartier River Power Co., under contract with Ross, Barry & Co., of Toronto; estimated capacity at least 5,000 h.p. The St. Maurice water power system, actually operated or about to be developed, consists of the Grande Mere Falls, 10,000 h.p., operated by the Laurentide Pulp and Lumber Co.; the Shawinigan Falls, where the Shawinigan Water & Power Co. has let a contract of $260,000 to Ross, Barry & Co. for a first development of 30,000 h.p., with possible increase to 150,000; the Gres Falls, which will be utilized as soon as the Great Northern track reaches them. This railway will then strike the Maskinonge river, where very powerful falls also exist. In the Lake St. John and Saguenay region are several waterfalls of first magnitude, viz., the Ouatchouan Falls, height 225 feet; the Metabetchouan, the Ashuapmouchouan, the Mistassini and the Peribonka Falls, all flowing into Lake St. John, and now of easy access by rail and boat; the Grand Discharge and the Saguenay Rapids between the lake and the town of Chicoutimi; and last but not least, the 10,000 h.p. falls of Chicoutimi river, already operated by the Chicoutimi Pulp Co. Other large waterfalls are reported to exist on both rivers, Manitou and Marguerite, on the North shore of the St. Lawrence below the Saguenay, one of which of an estimated capacity of 100,000 h.p., is to be worked up, it is said, by Geo. Taylor, Toronto. A careful estimate, generally considered very conservative, and limited to the dry season minimum, and to the points now accessible by rail or water, puts down at 250,000 h.p. the amount of water power available in that part of the country, of which only a very small portion is now being developed.

GRANDE MERE.

The plant of the Laurentide Pulp & Lumber Co. at Grande Mere, as seen a few weeks ago before the opening of the paper mills, comprised a high grade masonry dam, with 15-foot feeder pipes connected with 14 foot water wheels in the paper mills; a large stone-built pulp mill; a saw mill; a massive group of brick buildings, consisting of a 215x60 foot screen house, a 210x60 foot beater house, annexed at right angles to the paper mills installed in two parallel two-story galleries of an equal size of 200x70 feet, the paper machinery proper being Pusey & Jones' machines, of Wilmington, Del., and the finishing and packing room, 170x60 feet; the acid tower, 40 feet square and 146 feet high, built on the edge of the hill, and containing nine vertical tubes of 3 feet diameter for preparing lime; the sulphur house, 160x25 feet; the filter house, 50x80 feet; the digester house, 90x70, besides the company's stores and offices, the machine shops, water reservoirs, rail elevators, coal slides, steam log drivers, freight sheds, etc. All the buildings, save the acid tower, are lighted by electricity, and are fire-proof, with arched brick floors and slate roofings. The Sturtevant heating system is exclusively used in the paper mills. Provision has been made as to space and power for future enlargement of the mills. During construction, the number of men employed has reached 1,400. The mills in operation will employ an average of 800 to 900 hands. A little town has grown on the adjacent hill around the mills; the population is now estimated at 2,500. The daily capacity of the Grande Mere mills is 40 tons news print, 100 tons dry pulp, 35 tons cardboard, and 50 tons sulphite pulp, and their daily consumption is given at 50 tons coal, 10 tons limestone, 15 tons general goods and 200 cords of wood. Grande Mere is a station of the Great Northern, giving direct connection with Quebec; to reach Grande Mere, the trains cross the St. Maurice on a beautiful cantilever bridge, about a mile below the Falls. Connection is made at Garneau Junction with the C.P.R. on Three Rivers.

PROPOSED DEVELOPMENT OF SHAWINIGAN FALLS.

The plan designed by T. Pringle & Son, civil engineers, Montreal, and on which a contract has been signed with Ross, Barry & Co., specifies the immediate development of 30,000 h.p., which may be hereafter increased to 150,000. The work is described as follows: Truss, boom and cribwork across the river, a little distance above the Falls, such boom of sufficient depth and at such angle as to deflect all floating ice debris over the Falls. Head race or inlet canal from truss boom in westerly direction, said canal to be 1,100 feet long, width varying from 100 to 400 feet at the entrance, excavated to such a depth as to contain in all seasons not less than 16 feet of water, with a speed inland of two feet a second for the 30,000 h.p. development. Banks of head race to be protected where too low with cribwork piers, dry stone walls and filling embankments. Bulkhead or dam of high grade concrete masonry, and fitted with suitable racks and steel inlet gates for feeder pipes, said bulkhead to be carried well up above the flood level. As to feeder pipes, first development contemplates installation of three large pipes of 13 foot diameter each, and one smaller pipe 4 feet diameter for operating compressors and exciters, the large ones having each a capacity of 10,000 h.p., and the latter about 6,000 h.p., all pipes supported at suitable intervals by heavy masonry saddles built in cement mortar. Distance between bulkhead and power house about 500 feet. The power house foundations are built up with massive bed of concrete masonry, arched for feeder pipes, tail race, etc. Power units in first development consist of two turbines on horizontal shaft, direct connected to 5,000 h.p. generators of modern design. Two of the power units to be supplied from each feeder pipe; 120 feet is the nominal head under which turbines will operate. Provision is made for heavy valves between feeder pipes and water-wheel cases, and it is contemplated that all valves will be controlled either by pneumatic or hydraulic pressure. All feeder pipes will be provided with suitable air cushions and relief valves to take up any possible water hammer. Power house building to be a substantial steel frame building, filled in with brick and equipped with suitable traveling cranes to handle all the heavy apparatus. From power house into lower bay the plan provides for a tail race of sufficient capacity, the sides of which will be protected with rip rap masonry. The whole work to be of a most substantial and permanent character and design. The head race bottom, foundations of bulkhead, supports of feed pipes and powerhouse foundations to rest on solid rock. The future extension contemplated may consist of widening the inlet canal on one side inland, and extending bulkhead and power house in the same direction, and further extension can still be made by constructing bulkheads in upper bay carrying feeder pipes at different points and discharging in lower basin or in the mouth of Shawinigan river.

OTTAWA SHIP CANAL.

Editor CANADIAN ENGINEER.

It may be news to some of your younger readers that a survey of the Ottawa for a ship canal was made in 1855; and work upon it, near Arnprior, performed in 1858. The canal was located (for a political effect) on the Quebec side of the Rapides des Chats; but the rock proved so very hard and tough that little was effected at the time. The site for a canal is an ideal one, being almost an air line from the Straits of Mackinac to Montreal; the water supply is quite sufficient, except on the watershed between the French and Ottawa waters, near North Bay; while the general character is that of a series of lake-like expanses, separated by narrow ridges of rock, causing rapids. Thus French River, forming 80 miles of the route, needs only one lock, with a lift of 5 feet in the first 30 miles; and two 10 feet lifts bring us to the only cataract of 25 feet in a hundred yards, about ten miles from Lake Nipissing, which affords 20 miles more of free navigation about 18 feet deep. From North Bay to Trout Lake (emptying into the Ottawa), is 4 miles, with a rise of 19 feet, along a small river, affording a canoe route with a very short portage over a low flat rock. The descent of the Mattawa is the most difficult portion of the whole route, nearly all the cuttings being in Laurentian rock, and the rapids frequent. The water for lockage, too, might be scant for a ship canal. From Mattawa village to Pembroke, the bed of the Ottawa is generally a swift current, with frequent rapids, calling for a number of locks; but a few large dams may alter this portion materially for the better. From Pembroke to Ottawa city the greater part of the way consists of lakes separated by ridges of rock forming at Fitzroy Harbor a semi-circle of cascades nearly three miles in extent, with a fall of about 30 feet. The capacity of such a location for the development of power is almost beyond computation. Between the mouth of French River and Ottawa city probably a million horse-power might be developed and utilized, and thus give birth to a chain of manufacturing towns, similar to what has grown up along the Welland canal. Indeed, when the climate, minerals and timber are considered, with the shorter route to European markets, the advantage is decidedly in favor of the Ottawa canal system. Thus much in favor. On the other hand, it will cost a good deal to ensure a constant channel through Lake Nipissing, whose bottom consists of laurentian gneiss, overlaid with shifting sands, and subject to frequent gales. The long swift current between Mattawa and Les Alumettes Lake will be costly to deepen and regulate, while the rafts of timber will claim right of way for many years and impede navigation to some extent. The length of the season free from ice will be seriously curtailed in the vicinity of Mattawa, its most northerly angle. As a native of the Upper Ottawa, and long familiar with French River valley, I will earnestly hope that such a Klondyke of undeveloped possibilities—commercial, manufacturing, mining and agricultural—may yet prove Canada's brightest diadem.

THOMAS FROOD.

LITERARY NOTES.

The Niagara Falls, Ont., Record issued a special Christmas number this year of 20 pages, which is profusely illustrated, and also contains a history of the neighborhood, which is very interesting.

We have received a copy of the President's address for 1898, of the American Society of Mechanical Engineers, being a reprint of part of Vol. XX. of the published Transactions of the Society. Chas. Wallace Hunt, the president, discusses the subject, "The Engineer; his work, his ethics, his pleasures."

Theatre Sanitation, by Wm. Paul Gerhard, C.E., is an interesting pamphlet which contains the paper read at the meeting of the American Public Health Association at Ottawa, and is reprinted from The Sanitarian for December, 1898. Therein the theory and practice of theatre sanitation is taken up under the following heads: Drainage, plumbing, water supply, ventilation, lighting, general sanitation. Mr. Gerhard is also the author of a very interesting work of 500 pages, entitled Sanitary Engineering of Buildings; published by Wm. T. Comstock, 23 Warren street, New York, N.Y.

We have received a number of very handsome calendars for 1899, among others from the Boiler Inspection and Insurance Co., Toronto; the B. Greening Wire Co., Hamilton, Ont.; John Bertram & Sons, the Canada Tool Works, Dundas, Ont.; A. F. Bury Austin, lumber and timber, Montreal

The Dodge Mnfg. Co., Limited, York street, Toronto, has sent us a copy of the 100 page catalogue which is issued from the office of the Dodge Mnfg. Co., Mishawaka, Ind., U.S. The catalogue is very finely illustrated with a large number of photo-engravings, which show the various applications which may be made of the rope method of transmitting power.

We have received a pamphlet of some 20 pages containing a graphical method for constructing the catenary, with exact drawing board constructions for all cases of the problem of plotting the curve of a flexible cord of uniform weight; including a review of notable properties of the curve with their graphical representations, by Walter K. Palmer, M.E., School of University of Kansas, Lawrence.

The Intelligencer, Belleville, Ont., has issued an almanac of some seventy pages, which contains all the information usually found in a volume of this kind. In the space usually occupied by jokes, The Intelligencer almanac has printed copious extracts from its own editorial columns, and those of its leading contemporaries, under such headings as, "The Political History of 1898," "General Postal Regulations," "The Public Debt," "The Preferential Trade Failure."

The Philadelphia Museum is a national and international bureau of commerce, with large libraries of foreign government documents, with a public journal room containing over eleven hundred journals, and with an immense museum drawn from every country in the world. The periodicals are constantly referred to by persons in search of specific information. The Canadian Engineer is always to be found in the reading room. The Philadelphia Commercial Museum has recently issued a pamphlet stating the objects of the museum and giving a list of its officers.

Walter K. Palmer M.E., School of Engineering, University of Kansas, Lawrence, has published "The Designing of Cone Pulleys; a non-approximate graphical solution for the problem of proportioning cone pulleys," with concise practical rules. The following are among some of the heads under which the discussion falls: General Analysis, Case I., Open Belts; Case II., Crossed Belts, Comparison of Existing Methods; the Reuleaux Analysis, the Final Diagram, Analysis for Crossed Belts, Rules for Proportioning the Steps of Cone Pulleys, Special Rules for Small Three-Step Cones.

The January number of The Canadian Magazine contains an article of great interest on "Great Britain vs. United States," by R. E. Kingsford. This is a thoughtful and well-considered attempt to throw light on the present craze in England for an alliance with the United States, and its bearing on Canada. The continuation of Johanna E. Wood's story "A Daughter of Witches," sustains the interest of the reader. The only flaw in the number is a mass of biographical details of second-rate actors, who were not, thank goodness, born in Canada. Such matter should be found only in ten-cent magazines.

NEWFOUNDLAND NOTES.

Some time ago J. S. McLennan, treasurer of the Dominion Coal Co., proceeded to Newfoundland to look into some iron deposits owned by his company, as well as to examine the large iron deposits at Belle Island, owned and worked by Graham Fraser and others for the Ferrona Company, of Pictou. A Newfoundland informant states that Mr. McLennan has succeeded in purchasing the Ferrona areas, as well as several other smaller areas north. Mr. McLennan has also made arrangements for the mining, next season, of 2,000 tons per week of the ore.

The St. Johns Herald stated recently that another great discovery of copper has been made in Green Bay, samples of which, on analysis, were found to yield 43 per cent. of the mineral. In evidence of the splendid position of Newfoundland copper in the British markets at present, we may quote the following extract from The London Financial Times, of Nov. 9: The SS. "Regulus" arrived at Swansea on Monday from Little

Bay with the first cargo of copper ore raised in Newfoundland by the company. The consignment has been sold by Messrs. Henry Bath & Son at the top price of the day. Another cargo, which will be loaded as soon as the open water permits, is expected shortly.

Hon. Capt. Kean and H. D. Reid have returned from Glasgow, where they arranged for the building of the fleet of seven steamers called for by the Coastal mail service which forms a feature of the Reid contract. The steamers are being built with a view to the future development of the services and not to the existing conditions. They are all to be finished exactly like the "Bruce," both in their structure and interior fittings. They will be specially fortified to resist ice; they will have the very latest devices in machinery, their equipment will include electric search-lights, etc.

BRITISH SEWAGE COMMISSION.

In reply to enquiries by The Canadian Engineer regarding the issue of the report of the Royal Commission on Sewage Disposal, now sitting in England, a note from Lord Iddesleigh sets right some misconceptions on the subject. His Lordship, who is chairman of the commission, says: "It has been brought to the notice of the Royal Commission on Sewage Disposal that there is a tendency on the part of some manufacturers and local authorities to postpone the carrying out of woks for the purification of trade refuse and sewage until the Commission have issued their report, and I, therefore, think it desirable to state that a considerable time, perhaps even some years, must elapse before the Commission can arrive at any final conclusions on a subject which necessarily involves detailed and prolonged scientific investigation. Any such postponement would be viewed by the Commission with the gravest concern."

FIRES OF THE MONTH.

Dec. 8th. Northern Pacific and Manitoba Railway coal sheds, Belmont, Man.——Dec. 17th. Ontario Wind Engine & Pump Co.'s works, Toronto; damage, $3,000; fully insured.——Dec. 17th. The Toronto & Hamilton Sewer Pipe Co.'s Works, Hamilton, Ont.; damage, $35,000; insurance, $25,000. Dec. 21st. S. Greenshields & Co.'s dry goods warehouse, Montreal; loss on it and adjoining properties almost $1,000,000.——Dec. 20th. The Gardner Tool Co.'s premises, Sherbrooke, Que.; damage about $25,000.——Jan. 2nd. Toronto Rubber Shoe Manufacturing Co.'s factory at Port Dalhousie, Ont.; damages between $75,000 and $100,000.——Jan. 5th. Louis Brousseau's gas and electric lighting plant, St. Hyacinthe, Que.; damages about $10,000; partly insured.

THE DEPARTMENT OF CHEMISTRY, MCGILL UNIVERSITY.

The magnificent building devoted to chemistry and mining in McGill University, whose equipment has just been completed through the generosity of W. C. McDonald, whose gifts to the University have been so large and bestowed with such a wise discretion that McGill has been left in many directions with nothing to wish for. The portion of the building devoted to mining and metallurgy was described in The Canadian Engineer for June, 1898. The chemical department was opened with imposing ceremonies by Lord Strathcona and Mount Royal, Dec. 20th.

The chemistry building is now largely equipped and all the work of the chemistry department is being done inside its walls. The equipment is already extensive, but it is far from being what its managers intend it shall eventually become. Four floors in the new building are occupied by the laboratories, museums, class-rooms, offices, etc., and a fifth story, lofty and spacious, is designed for store rooms. Every part of the building has its separate connection with the ventilating fans in the roof, for the purpose of ordinary ventilation and for the speedy removal of the poisonous gases, etc. Internally the walls are finished largely in pressed and enamelled brick, with a free use of tiling both for floors and walls. The frames of the stairways are of iron, in ornamental designs, with slate steps, making them fireproof. The floors are mainly of polished hardwood, and handsomely finished wood has been employed in the ceilings. Several colors of enamelled brick are used in the halls and on the stairways, giving very pretty effects in the borders. Perhaps the handsomest portions of the interior are the entrance hall, the library and reading-room, the ladies' room, the large lecture theatre, and the private rooms of the professors. The entrance hall has a handsome mosaic flooring, and walls partially covered with beautifully grained and colored stone.

The library, with its cosy alcove corner gives a pretty effect. The floor, ceiling and fixtures are of light-colored wood, highly polished, and the walls are of a deep, soft red color, with borders of a creamy yellow tint. The electric light fixtures are of brass; the design is a very handsome one. The steel beams of the ceiling are cased in beautifully grained spruce dividing the expanse into square panels, bordered exquisitely in wood. The ladies' room offers to the students of the Donalda department more luxurious accommodation than any other part of the university. Dr. Harrington's rooms, situated next to the library, are similar to that apartment in finish, and, like the library, are very well lighted. The lecture theatre has ceiling, floors, seats and fixtures of oiled wood, very light in color, and in the walls cream and white bricks are largely used, the whole giving a marvellously bright effect. High up on the walls in a border of ornamental brick and tile in separate panels, are recorded the names of the greatest chemists at different stages in the development of the science. This border runs around three sides of the room. Above the platform is inscribed the name of Geber, the most illustrious of the chemists of the alchemistic order, which was in its prime in the eighth century, when chemical experiments were carried on mainly for the discovery of methods of making precious metals and stones. Following this came the Iatrochemical period, when the science was in the hands of men who delved into its secrets with a view to finding medicines for the cure of diseases. Then came the period of the Flogiston theory, represented on the walls by the name of Stahl, one of the greatest exponents of that famous but unsupported belief. The name of Lavoisier, who struck the secret of combustion, marks the beginning of the modern period when chemistry began to be studied along the present broad lines. Lavoisier, by the way, was beheaded during the French revolution. Some of the names inscribed of the great chemists who have become famous since are, Davy, Dalton, Gay, Lussac, Faraday, Wohler, Liebig, Bunsen, Hoffman and Fresenius. A lantern is also included in the lecture room equipment as lantern slides are used to illustrate the lectures. The theatre will accommodate 250 students.

An enumeration of the rooms of the building gives some idea of the work which is carried on. Beginning at the bottom and omitting mention of the mining department's quarters at the rear, there is the sub-basement. Here are set up the furnaces for the heating of the building and a fan room from which fresh air is forced through many flues into every part of the building. A clever device has been used to heat this air. The exhaust steam from the engines in the engineering building is brought over and entering clusters of coils heats the fresh air as it enters the buildings. This action condenses the steam and the hot water resulting is automatically conveyed back into the boilers whence it came. On the next floor is the lower entrance to the lecture theatre and adjoining the theatre the rooms where are prepared the apparatus used in the lectures. On the same floor are the lavatories and locker room, the former of the most modern type, well tiled and commodious. All the rear portion of the ground floor is taken up by the elementary laboratory with places for eighty students. The accommodation for each one includes a sink, cupboard and drawers for apparatus and self-room for bottles containing the ordinary solutions used in the determination of the more easily handled elements. On the ground floor is the students' entrance to the lecture theatre and an entrance to the balcony of that apartment. There is also an instructor's room, a balance room, a room for water analysis or special research, the students' reading room, the janitor's office, the ladies' room already described, and a waiting room for visitors.

On the first floor is the laboratory for quantitative analysis. Here the advanced students are working; the apartment is as large as the elementary laboratory and will accommodate forty persons at work. Adjoining is a balance room, instructor's room, a lecture room and the electrolytic laboratory. In these

days of electricity, electrolysis has become an important study, and it is gratifying to have a special place for the work with all the necessary apparatus of the newest design at hand. There is also a room for the analysis of iron and steel and a large apartment laid out as a museum of chemical products. In the front of the building are the library and Dr. Harrington's rooms. On the second floor are the large qualitative laboratories, with accommodation for sixty men, balance room, Mr. Evans' office and private laboratory, organic chemistry classroom, combustion room, a room for gas analysis, supply rooms and Dr. Walker's office and private laboratory.

The third floor includes an optical room for the study of crystals and rooms devoted to the study of physical chemistry, which department of late has attracted a good deal of attention. Dr. Adams' petrographical laboratory is also situated on this floor and everything necessary for the microscopic study of rock specimens provided. There is also a large museum for economic minerals, a lecture-room for mineralogy and a special room for blow-pipe determinative mineralogy, which we have already described. Here also are the photographic rooms, including two dark rooms on the maze principle, without doors. There are several fine cameras and an enlarging camera included in the outfit. The attic is by no means a rough, unfinished room. It is lofty with walls painted white and an oiled hardwood floor. Here also are the larger store-rooms, the ventilating fans run by an electric motor, and a large still for the production of distilled water; this machine is automatic in action, of large capacity and supplies distilled water to all the laboratories through tin pipes with tinned joints.

The apparatus of the chemistry department consists very largely in a large number of small implements and devices for particular uses, hard to describe to anyone but a chemist. Outside of this class some portions of the equipment are notable. Balances are provided in generous numbers in the balance rooms adjoining each of the laboratories. The more delicate of these enclosed in glass cases to prevent vibrations caused by currents of air, weigh accurately down to the tenths of a milligramme. The equipment for research in the department of physical chemistry is very complete, particularly such apparatus as is required for the chemical determination of molecular weights. The quantity of material used in lecture illustration is already very large, but further large shipments are now on their way from Europe. The photographic equipment includes lanterns for projection and a projection microscope, so that views of microscopic objects may be thrown upon the screen before a whole class. The set of platinum dishes and crucibles represents a very large amount of money, a bowl about three inches across costing $150. There are several hot-air motors in the laboratories, and automatic devices for many purposes, such as maintaining a bath of uniform temperature for a year without any attention whatever. In every laboratory there are pipes connected with the large vacuum pump, so that vacuum is easily obtainable in a very short time. A perfect telephone system throughout every part of the building saves a great deal of time.

METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports of interest to the metal trades during November, 1897 and 1898, and the eleven months ending November, 1897 and 1898:—

	Month of November.		Eleven months ending November.	
	1897.	1898.	1897.	1898.
Hardware	£5,224	£2,126	£63,817	£24,168
Cutlery	..	4,111	..	49,525
Pig iron	2,724	1,401	9,209	11,280
Bar, etc.	751	1,506	8,629	11,662
Railroad	11	64	45,789	25,218
Hoops, sheets, etc	6,562	10,847	77,823	63,229
Galvanized sheets	3,620	9,981	52,606	65,267
Tin plates	54,450	35,094	217,421	158,976
Cast, wrought, etc., iron	3,090	3,241	31,979	31,894
Old (for re-manufacture)	1,201	..	7,684	3,574
Steel	4,455	3,681	51,956	47,111
Lead	3,451	3,851	27,401	35,876
Tin, unwrought	2,386	1,862	17,369	17,269
Alkali	8,390	6,397	43,239	48,872
Cement	1,306	1,620	19,797	25,382

Industrial Notes.

Cranbrook, B.C., is to have a system of waterworks.

Orillia is to have a new high school to cost about $9,000.

The Aylmer Iron Works have built an extension to their foundry.

Hospital extension is contemplated in Brantford, at a cost of $5,000.

Work is to commence at once on the Ymir, B.C., waterworks.

W. A. Kribs, M.L.A. proposes to start a box factory at Hespeler, Ont.

H. & F. Giddings & Co., Granby, Que., have put in a large Leonard boiler.

M. Beatty & Sons, Welland, Ont., are now running their works by natural gas.

Merritton, Ont., has passed a by-law applying $6,000 to waterworks extension.

The new pulp mill at Mispec, N.B., will be ready for operation next March or April.

The Sydenham Glass Co., of Wallaceburg, Ont., has begun to manufacture flint glass.

A. W. Law is taking charge of the Facer Car Wheel Works. Perth, Ont.—Perth Expositor.

Adams, Burns & Co., of Bathurst, N.B., are looking into the prospects of a pulp mill there.

A new steel canal bridge, the full width of the street, will be built on Maria street, Ottawa.

Jno. Bertram & Sons, Dundas, Ont., are shipping largely to European markets this winter.

T. H. DeCew, Essex, Ont., is about to establish a large stave factory at Fenelon Falls, Ont.

The ratepayers of Belleville have passed the by-law to bonus a carpet factory and rolling mill.

The Stayner, Ont., waterworks by-law has passed. The system is estimated to cost $24,000.

The Ottawa Steel Range Company, Ottawa, has offered to compromise at 50 cents on the dollar.

Dowling & Ottewell, Clover Bar, contemplate erecting a 100 barrel flour mill at Edmonton, Alta.

A canning establishment is proposed at Sussex, N.B., as a branch of the Woodstock, N.B., canning factory.

It is proposed at London to build a $75,000 breakwater to prevent flooding in the western part of the city.

The Imperial Oil Co. has bought out the Bushnell Co.'s refineries at Sarnia and will carry on its business.

A by-law to raise $12,000 to construct main sewers in Pembroke was carried January 1st by a majority of 27.

A system of waterworks is to be put in Cascade City, B.C.

Secord Bros., machinists, are starting business in Winnipeg.

A new summer hotel to cost $40,000 is in contemplation at Danville, Que.; the land around the hotel is to be laid out as a park.

A large number of local companies are being organized in Ontario to manufacture peat fuel on the system recently patented.

A number of Canadian furniture manufacturers have orders from British houses and from firms in South Africa, Australia and India.

The foundry belonging to the estate of John Ledingham, St. John's Nfld., has been sold to Terra Nova Engine & Boiler Works, Limited.

The Sawyer-Massey Co. has decided to remain in Hamilton, and contemplates extending its agricultural implement works in the spring.

The Yule and Tate estates want $50,000 for the bridge over the Richelieu river at Chambly, Que., which after 50 years has reverted to the crown.

Rider & Kitchener, veneer and excelsior manufacturers, Brampton, Ont., are negotiating, with a view of establishing their plant in Lindsay, Ont.

The Nova Scotia Carriage Co. has ordered a 50-h.p. engine and boiler from the Robb Engineering Co., for the new factory it is building at Kentville, N.S.

The Carborundum Company are just finishing an addition to their Canadian branch, and it is expected will be calling for more power in the near future.

The Rand Drill Co. has accepted the $15,000 bonus offered by Sherbrooke, Que., and will remain in that town, and will erect large works in the early spring.

The Londonderry Iron Co. has gone into liquidation, and met its creditors January 5th. The order for liquidation was granted on petition of John L. Reay.

The representative of a woolen company has been in Brantford looking at the old Wincey mill as the possible site of a new woolen mill or knitting factory.

The Aptees Collapsible Box & Veneer Co., West River, Albert Co., N.B., have bought a 125-h.p. boiler from the Robb Engineering Co., Ltd., Amherst, N.S.

Judge Morgan, Toronto, has recently given a number of decisions against users of gas lamps, which has been decided as infringing the Auer Light Co.'s patents.

The Berlin Brush Works, recently burnt out, is being reorganized and located at Waterloo, Ont. The factory starts up this month with fifteen hands to begin on,

Grantham, Fisher & Co., Ltd., Yarmouth, N.S., are applying for incorporation to manufacture cordage. W. H. Avis, formerly of Toronto, is one of the promoters.

An evidence of the prosperity of Toronto is the subscription of $250,000 for the establishment of another paving brick company near Mimico. J. W. McBride is manager.

St. Catharines will offer inducements to the Toronto Rubber Co. to rebuild in that city the works recently destroyed at Port Dalhousie. Merritton is also after the works.

The power plant for the new butter factory at Cowansville, Que., has arrived, and is now being installed. The plant was furnished by the Jenckes Machine Co., Sherbrooke, Que.

Stratford will soon vote on a by-law granting a loan of $30,000 to the Whyte-Pork Packing Co., a concern that promises to spend $50,000 in the erection of buildings, machinery, etc.

Alphonse Pallascio, dealer in hardware and house furnishings, Montreal, has assigned and filed his statement. The list of creditors includes 135 names and the total liabilities amount to $228,000.

The St. John's, Nfld. Gas Light Co., is remodeling its plant and doubling its capacity, which in the spring will be 125,000 cubic feet. Gas for fuel and power is now supplied there at $1.50 per thousand.

The Standard Drain Pipe Co., St. Johns, Que., has lately improved its facilities for handling raw stock by the installation of a Dake Hoisting Engine, from the Jenckes Machine Co., Sherbrooke, Que.

The John Gillies Estate Co., Carleton Place, Ont., has secured the patent on a new gas and gasoline engine for steam launches—a simple and economical power—and will put them on the market at once.

The town council of St. Lambert, Que., have considerable difficulty in deciding whether the waterworks have been installed according to contract. McConnell & Marion have reported against the work as done.

L. L. Sheldon, of Aylmer, Ont. has disposed of his interest in the Aylmer Iron Works to E. C Jenkins, Springfield. The new firm will therefore consist of Henry Sheldon and Mr. Jenkins, who will at once add a lot of new and improved machinery.

The De Laval Manufacturing Company, with capital stock of $10,000, is asking for incorporation in Quebec for general trade in centrifugal machinery and other purposes. The applicants are: J. S. Clunie, W. Carey, C. W. Schnare, M. J. F. Quinn, Montreal, and F. J. Arend, New York.

A by-law to authorize the issue of debentures for the sum of $110,000 for the construction of waterworks and sewerage systems for the Town of Oshawa, is to be submitted to the ratepayers to vote upon on January 21.

An American syndicate has bought five acres of ground at Thorold, on which it is proposed to erect works for the manufacture of caustic soda and bleaching powder. It is reported the capacity of the works will be 100 tons per day.

The last car-load of old plates, bolts, etc., from the old Victoria tubular bridge was shipped to Hamilton, Ont., Dec. 15th, consigned to the Ontario foundry of that city. This completes a shipment of 477 car loads of this material.

The large boiler for the new mills of the Frontenac Milling Co., Kingston, have arrived from Sherbrooke, Que., and are being set in. The compound condensing engine is expected shortly, and the whole plant it is expected will be in operation early in 1899.

The Massachusetts Institute of Technology, Boston, has during the past year received gifts amounting to almost one million dollars. A travelling fellowship in Architectural Department has been established. There were 1,171 students in attendance during the year.

Sewrey's foundry, Barrie, Ont., which has been practically idle nearly three years, and has a capacity and machinery for eighty workmen, has passed into the possession of Dyment & Butterfield, who will manufacture engines, boilers, mill machinery, ploughs, and other farm implements.

George McAvity and G. G. Ruel, St. John; J D. Chipman, St. Stephen; Hon. F. P. Thompson, Fredericton and Joshua Peters, of Moncton, are seeking incorporation as the New Brunswick Cold Storage Company, Limited; capital, $250,000; Rothesay is to be the chief place of business.

The Canada Screw Co., located at Hamilton, which was owned by the American Screw Co., of Providence, R.I., has been disposed of to a Canadian company, with C. A. Birge, the present manager, at the head. The concern has a capital stock of $5,000,000 and the business will be carried on as usual.

The Northey Mnfg. Co. has recently shipped a hydraulic mining pump, weighing 40,000 lbs., and having a capacity of 2,000 gallons per minute, to Ashcroft, B.C. It has also built a triplex power pump of 5,000,000 gallons capacity for the Montreal Water and Power Company. This is the largest pump of its kind ever made in America, and will be operated by a 450-h.p. motor.

A number of men are busy at the Standard Chemical Co.'s works, where Mr. Chute is rushing forward the completion of the new bench of retorts. There are fifty of these huge retorts in a row. Mr. Butler is arranging for laying down the railway tracks through the new sheds, and the old works have been practically rebuilt.—Deseronto Tribune.

Arnprior, Ont., has offered a Cleveland, Ohio, firm, manufacturers of tacks, nails, bolts and files, which are looking for some suitable place to locate outside of Cleveland, a free site, consisting of four acres lying south of the C.P.R. track and having as one of their boundaries the Madawaska river. An exemption from taxation would also probably be given.

Prof. Ruttan and Prof. Nicholson, of McGill University, Montreal, are making tests in connection with Emerson's process for the extraction of different products from sawdust and for the manufacture of calcium carbide therefrom. Prof. Ruttan is stated to have said that the machine is a success, but the products are new, and consequently it will take some time before he will be able to report as to their commercial value.

R. H. Buchanan & Co., Montreal, who represent the Blake & Knowles steam pump for Canada, have received the contract for the fire protection plant for the Protestant Insane Asylum at Verdun, Que. They have supplied the Montreal Rolling Mills Co. with one hydraulic steam pump; Linton & Co., boot and shoe manufacturers, a boiler feeder; a pumping plant to the St. Vincent de Paul Penitentiary. The suction pipe, 2,000 feet long, for the Merchants' Mnfg. Co., St. Henry, Que., was completed on the 11th Dec. Buchanan & Co. have put in the longest suction pipes in Canada and all are giving thorough satisfaction.

The Dominion Radiator Company, Dufferin street, Toronto, is selling its wares in all parts of the world. Among the notable buildings and institutions which are being warmed by radiators made by the Dominion Company are the Palace of Justice at Praetoria, South Africa; the Park Hospital at Lewisham, near London, England, an institution composed of 29 separate buildings and covering 56 acres; the Edinburgh County Hospital and the Imperial Board of Trade building, Berlin. The orders for some of these institutions were obtained in the face of the keenest United States competition. Royalty owes its comforts during cold weather to Canadian radiators in some instances at least, for the Dominion Company supplied the entire heating apparatus for the German Emperor's palace at Berlin, and for King Oscar's at Stockholm. The Old Parliament Buildings at Dublin were also entirely equipped with heating apparatus by this company.

The exploring party under Alex. Niven, P.L.S., left Haileybury, on Lake Temiscamingue, on 23rd of May last, to complete the survey of the boundary between Nipissing and Algoma. In 1896 the line was run north from the northeast angle of the township of Lumsden, for a distance of 120 miles. During the past summer the boundary was further surveyed for a distance of 180 miles from the point where operations ceased two years ago to a point four miles north of Moose river, on James' Bay. Having successfully accomplished the work allotted to them, the party started on the 10th of October on the return journey by way of the Abitibi river and Abitibi lake and Lake Temiscamingue. Had the weather proved favorable, the journey, which is about 425 miles, would have been accomplished in six weeks. But severe weather set in earlier than was anticipated, and the water stretches began to freeze, rendering canoeing a difficult matter at first, and afterwards an impossibility. The consequence was that the explorers did not reach Bay de Pierre, on Lake Temiscamingue, which was practically the end of their journey, until the 25th November, or a month and fourteen days after leaving Moose Factory.

Electric Flashes.

Prescott, Ont., has passed a by-law to raise $15,000 for a municipal electric light plant.

Vancouver, B.C., wishes to purchase the electric railway. It is stated the report is denied, however.

The Barrie Electric Light Co. difficulty has been settled by an agreement by which the town will acquire the works for $22,501.

The Packard Electric Co., Ltd., St. Catharines, Ont, has sent out a handsomely printed New Year's greeting to its friends and customers.

Thomas E. Hillman, engineer, Hamilton, has been instructed to survey two lines for an electric railway from that city to Guelph and Berlin.

The municipality of Chatham, Ont., intends to install a new dynamo for arc lighting. It runs the arc lights and the Chatham Gas Co. the incandescent.

The Robb Engineering Co., of Amherst, N.S., has received an order from New York parties for two 300-h.p. engines for an electric railway in Australia.

Wm. Stuart, Ottawa, has been awarded the contract for building the electric power house on the Soulanges canal. The amount is in the vicinity of $50,000.

It is stated that electrical iron smelting is being successfully carried on at Sault Ste. Marie. F. H. Clergue states that as yet there are no exact details available for publication.

By-laws relating to the establishment of electric lighting plants at Forest and at St. Thomas, Ont., have been defeated; Thorold has passed one to raise $5,000 to extend its plant.

The electric lighting plant recently sold to the corporation of the town of Campbellton, was started up for Christmas lighting. The driving power is water, and the electrical apparatus is of the Royal Electric Company's S.K.C. two-phase type for arc and incandescent lighting and power.

The Trail smelter is now run by power furnished by the West Kootenay Power & Light Co. from Bonnington Falls.

The large elevator of the J. G King Company, of Port Arthur, Ont., is being lighted throughout by electricity, the entire plant being furnished by the Royal Electric Company of Montreal.

The Yarmouth Times says the Street Railway Company of that town intend making quite extensive improvements in their cars. New motors of the latest type have been ordered and will probably arrive shortly.

The Gurney-Tilden Co., Hamilton, Ont., is now operating its entire works by electric power. It has installed two 20-h.p., and one 30-h.p. S.K.C. two-phase motors, and gets the current from the Cataract Power Co.

The 60-k.w., S.K.C. generator of the Dundas Electric Co., has been placed in position. They expect to have their water power in operation in a few days, and will begin the lighting of the city by the 15th of January.

G. H. Carroll, J. F. Boultbee, A. N. Parney, E.E., Paris, Ont., and W. J. Clark, T. McLaughlin, Toronto, have been incorporated as the Grand River Electrical Power Co., Ltd.; capital, $95,000; chief place of business, Paris, Ont.

E. A. C. Pew is negotiating with capitalists to start manufactures at Jordan, and thus afford a market for the power to be developed by the raceway from the Welland river, which enterprise he has been promoting for some time past.

The Kingston News urges the municipalization of the gas and electric works of the city, and the appointment of a commission to find out what water powers are available within range of the city for increasing the city's electric power.

M. Letheule, an electrical engineer of Paris, France, was in Quebec recently. He was sent by the French Government to visit Canada and examine and report for French capitalists on the application of electricity for industrial purposes.

The Dominion Bridge Company, Montreal, has just completed the installation of an arc lighting system in its large works at Lachine, Que. The dynamo and arc lamps were manufactured by the W. A. Johnson Electric Company, Toronto.

The Cannington Echo reports that the newly formed Victoria Telephone Co. will apply for incorporation and erect poles in the spring. The first lines will run between Beaverton and Argyle, Cannington and Sutton, and from Oakwood to Lindsay.

The flour mill of Lake & Bailey, Hamilton, is being driven by a 75-h.p. S.K.C. synchronous motor, which has been in operation two weeks, and is giving perfect satisfaction. They have shut down their steam plant and hope they will not have to go back to it again.

The W. A. Johnson Electric Company is installing an alternating plant for the corporation of Acton, which includes 55 street lamps, and all wiring for the town. The generator will be one of the inductor type alternators, which are meeting with much success.

The B. Greening Wire Works, Hamilton, have installed in their works a 50-h.p. S.K.C. induction motor. This motor is driving on to the same shafting as their engine, and is working very satisfactorily. They intend to replace their steam power entirely with electric motors.

The proposal to extend the Scarboro Electric Railway to Whitby and Oshawa with a connection to the C.P.R. at Myrtle is again being agitated. The extension to Oshawa and Whitby was provided for in the original charter. The line is controlled by the Toronto Railway Co.

The Gendron Manufacturing Company has recently installed a direct connected 600 light generator for lighting its factory. The order was placed with the W. A. Johnson Electric Company for both the generator and the wiring of factory. A 10x10 engine manufactured by the Goldie & McCulloch Co., of Galt, Ont., will be used.

Hull, Que., will operate and control a civic lighting plant, the by-law authorizing the City Council to raise debentures for the plant having been carried. The work of putting up the poles and wires will be commenced immediately. The Ottawa Electric Light Co. will probably supply the current for lighting until the town has its own dynamos ready for operation.

Wm. McKenzie, Fred. Nicholls and other Canadian capitalists have been negotiating for the street railway franchise in Havana, Cuba.

Galt, Ont., voted down the by-law devoting $67,750 to the purchase of the gas and electric light plants from the private company operating them.

The Eagle Knitting Co., Hamilton, Ont., has installed in its factory a 30-h.p. S.K.C. two-phase induction motor, which drives their knitting machinery, and has replaced their steam plant.

The Montreal Street Railway Co. has, it is stated, decided to build all its own cars at its Hochelaga workshops, and will add brass and iron foundries to the present plant. Cars will also be built for the Toronto and other lines.

The directors of the Hamilton, Chedoke and Ancaster Electric Railway have decided to apply for an amended charter to build a line to Brantford, Ont., to change the name to the Hamilton, Ancaster and Brantford Electric Railway Company, and to increase the capital stock from $100,000 to $200,000.

The plant for the town of Norwood, Ont., recently installed by the W. A. Johnson Electric Company, is giving much satisfaction to the purchaser. The machine is of the single-phase inductor alternator type of machines, which the company claims are practically indestructible, and have the excellent advantage of a very low speed.

The Alliston Electric Light Co., Alliston, Ont., is making changes in its lighting station, and has decided on increasing its incandescent light capacity, and for this purpose has placed an order with the Royal Electric Co., for one of its 60 k.w. S.K.C. two-phase machines, from which it will serve both arc and incandescent lights as well as power, which has heretofore been served by two machines.

Beeton, Ont., recently decided to install an electric light plant and are now highly pleased with it. The plant was installed about two months ago, and since then the number of lights have increased to nearly the capacity of their present machine, which is one of the W. A. Johnson Electric Company's inductor type of alternator, which are claimed to be so suitable for a plant where a repair shop is not near by.

The Wallaceburg Electric Light Co., Wallaceburg, Ont., which has been supplying arc lights for the town of Wallaceburg for a number of years, has decided to go into the incandescent lighting business, and has placed an order with the Royal Electric Co., for a 30 k.w. alternator, and 900 light capacity in S.K.C. transformers and material. It expects to have the lights in operation by the first of the new year.

The Hamilton Electric Light & Power Co. is installing in its lighting station two 240 k.w., and one 350 k.w. S.K.C. synchronous motors. These are to drive the shafting from which is operated the arc machines and the motor power service. The current for these motors is to be supplied by the Cataract Power Co. It is expected that the steam plant will be entirely shut down by the first of February. The incandescent light has been furnished from the Cataract Power Co.'s current for the past three months, and has been very satisfactory.

We are advised that since the purchase by the Westinghouse Manufacturing Company, of Pittsburgh, of the Walker Company, the Canadian representatives of the latter company, W. A. Johnson Electric Company, of Toronto, will continue to represent the combined interests of those companies in Western Canada. The advantages of this arrangement are quite plain, as the Westinghouse Company manufactures a most complete line of apparatus for long distance power transmission, including A.C. D.C. generators, rotary transformers, induction and revolving field generators.

In referring to the fire at the Greenshields warehouse on Victoria Square, Montreal, The Witness stated that the fire gave proof of the underground system of the Lachine Rapids Company being superior to overhead mains. The poles carrying the lighting mains of this company were broken and fell to the ground, together with the Street Railway and other companies' wires, which lay in a mass on the ground but notwithstanding this, the Lachine Rapids Hydraulic & Land Company were enabled to give every customer on their system light long before daylight, owing to the fact that they have an underground system. Before giving their customers light, broken wires and poles had to be replaced.

The Montreal Gazette recently stated that the Graburn and Blaney Canadian patent of the Graburn electrical thawing process has been sold by the inventor, Nelson Graburn, of Montreal, to the Electrical Thawing Syndicate, Ltd., London, Eng., for £7,000, and one-quarter interest in the company. The patent is intended to be used in countries like the Klondyke, where mining is carried on with the ground being frozen to a considerable depth. It provides for specially constructed dynamos and electrodes, the latter being placed against the walls of the shaft, with a space of from five to six feet of ground intervening; so that when the current is turned on, it has to cross the face of this space to complete the circuit and the ground contained therein, forming a resistance to the motion of the electricity, heat is generated and the ground thawed.

The Niagara Falls Power and Electric Company has won in the suit against the Niagara Falls Park Commissioners. The Park Commissioners claimed that the company had forfeited its charter because one clause, which said that by Nov. 1 it should have completed water connection for 25,000 horse-power and have ready for transmission 10,000 developed horse-power, had not been fulfilled. A series of questions were asked the Court of Common Pleas, and to-day the judgment of that court was: (1) That the agreement is not void by reason of the failure of the works by Nov. 1, 1898; (2) the Government or Commissioners may not, by reason of the non-generation of electricity by that date, declare the agreement void; (3) the Government and Commissioners are not relieved from the agreement not to grant any other company the right to take or use the waters of Niagara river.

W. A. Johnson, of the W. A. Johnson Electric Company, reports the recent sale of Westinghouse apparatus to the Metropolitan Railway Company, Toronto, for the extension of the present railway to Lake Simcoe. In the power house at Bond Lake will be installed two 60 cycle three-phase, A.C., D.C., generators, each of about 400 h.p., and a full complement of switchboard apparatus, step up transformers, lightning protection, etc., will be provided. The transmission voltage will be 16,500. There will be two rotary transformers, 60 cycles, three-phase, giving 570 volts on direct current side, these will be located in sub-stations about 14 miles from the generating stations, step-down static transformers being provided to reduce the voltage to that suitable for the rotaries. The generator switchboard will consist of eight marble panels, the sub-station switchboards of five marble panels with non-arcing and tank lightning arresters. In addition to the above there will be passenger and freight car equipments, including one quadruple equipment for heavy freight car and double equipments for two light freight cars; two double equipment for ordinary passenger cars and two quadruple equipments for heavy passenger coaches; the motors being used in these will be 38 B 50 h.p. each. The sale includes one 45 ton Baldwin-Westinghouse electric locomotor.

Marine News.

A Government engineer is examining the breakwater at Richibucto. If trade warrants it the entrance to the harbor will be deepened to 19 or 20 feet on the bar.

P. C. Jones, Belleville, Ont., has ordered from the Davis Dry Dock Company, of Kingston, a 16 h.p. fore and aft compound engine for a new steam launch to be completed by April next.

It is proposed to organize a local company at St. John's, Que., to build a steamer of a speed of 15 miles per hour and a capacity for 450 passengers, as an excursion boat on the Richelieu river.

Nagle & Hislop, traders of Fort Resolution and Fort Rae, have purchased the steamer "Sparrow," now in winter quarters at Grand Rapids. They will take her below Smith rapids in the spring and will run her from Smith rapids to the Arctic Ocean. This is the best built of all the steamers put on the Athabasca last summer.—Edmonton Bulletin.

It is said that Carrier, Laine & Co., the well-known Levis foundry and machine men, have undertaken to supply Captain Bernier, the would-be discoverer of the North Pole, gratis with the aluminum boats needed.

The Calvin Company launched at Garden Island recently the largest steamer ever built thereon. She is named the "India," and is intended for the timber carrying trade between western lake ports and Garden Island.

At a meeting of the directors of the Richelieu & Ontario Navigation Co. it was decided to add another boat to the present Saguenay fleet, and that the steamer "Saguenay" should be renovated before the opening of navigation. She will be lighted by electricity, and, when finished, be equal both in speed and accommodation to any of the company's other boats. A boat will be run, commencing at the opening of navigation, every day, including Sunday. This decision on the part of the board will be received with general satisfaction, as it will permit business men who have their families staying at Murray Bay to spend Sunday with their families, and return to business on Monday. A hotel at Murray Bay, to cost $30,000 and accommodate 300 guests is in contemplation by the company. The new steamer "Toronto" has had her trial trip, and will be put on the Lake Ontario route in the spring.

Personal.

Jno. Fisher, president, Small & Fisher Co., Ltd., iron founders, Woodstock, N.B., is dead.

E. T. Wilkie, C.E., Carleton Place, Ont., was married recently to Miss K. Snedden, Almonte.

Alex. Bowie, Ottawa, who was well-known among the early navigators of the Ottawa river, died January 1st.

David Higgins, an employee of the St. Lawrence Foundry, Toronto, fell into a vat of boiling water recently and was fatally burned.

F. C. Armstrong, who went to London last year to take an important position with Dick, Ker & Co., has returned to Canada to be married.

C. H. Mitchell, town engineer, Niagara Falls, Ont., has returned from Potsdam, N.Y., where he has been engaged on extensive public works now going on in that city.

C. E. Moore, son of C. P. Moore, proprietor of the R. Spence & Co. file works, Hamilton Ont., died very suddenly at Ottawa, recently. He travelled for his father's firm.

Hugh Muckleston, a graduate of the Royal Military College, Kingston, Ont., now in Victoria, has been ordered by the Government to go to Alaska on a survey expedition.

On Christmas Eve Raymond Smith, superintendent of the Sherbrooke, Que., street railway, was presented by the employees of the company with a fine gold ring as a token of esteem.

John H. Campbell, mining engineer, who has of late been working with the Virginia Gold Mining and Milling Company, of Arizona, has been engaged as mining engineer and superintendent of the Smuggler mine.

P. F. Hodgson, late chief signal engineer of the Grand Trunk, sailed on Jan. 8 for London on the Parisian from Halifax, and will look after the management of the Saxby & Farmer signal works at London, which appointment he received a month ago.

A. G. Allison, chief despatcher of the Grand Trunk at Toronto, has been dismissed on account of a recent accident to a freight train at Belleville. Mr. Allison has been forty years in the service, and is said to have been the oldest railway operator in America.

J. E. Muhlfeld, general foreman, motive power, machine and car departments of the Wabash, stationed at St. Thomas, Ont., has been appointed master mechanic of the western division of the Wabash, with headquarters at Fort Gratiot. He will be succeeded by F. Whitley, late of the Illinois Central.

Dr. S. A. Mitchell, son of John C. Mitchell, contractor, of Kingston, has been appointed research assistant at the Yerkes Observatory in connection with Chicago University. He is a graduate of Queen's College, where he secured the degree of M.A.; he also won the degree of Ph.D. at Johns Hopkins University, Baltimore.

The Quebec Telegraph says: Chevalier Chas. Baillairge, F.R.S.C., addressed a letter to Mayor Parent recently, tendering his resignation of the post which he has held so long as city engineer. Mr. Baillairge, who is 70 years old, and whose services to the city have merited the rest which he is now seeking, is the first city engineer, having been appointed to that post some thirty years ago under the mayoralty of Hon. Jos. Cauchon, subsequently Lieut.-Governor of Manitoba, previous to which he had held the position of city surveyor, succeeding Mr. Hamel.

Railway Matters.

The new Union station at Ottawa will cost about $130,000.

A company will, at the next session of Parliament seek incorporation with power to acquire and operate the Niagara Central Railway, and to extend it to Hamilton, Toronto, the Niagara River and Lake Ontario.

A handsomely illuminated address was last month presented to Charles M. Hays, general manager of the Grand Trunk, by the Brotherhood of Locomotive Firemen of America, in acknowledgement of courtesies received in connection with the last annual convention.

Orders have been placed with the Nova Scotia Steel Co. for 5,000 tons of steel rails for the I.C.R., weighing 80 pounds to the yard, which is 13 pounds heavier than that generally in use on the I.C.R.—New Glasgow Bulletin.

Jas. Hobson, the chief engineer of the Grand Trunk Railway, who was in charge of the reconstruction of the Victoria bridge, has received great praise for the eminent skill displayed in the manner in which the work was carried out under his direction. The fact that during the progress of the work, including the removal of the great tube, there was no delay of the business of the Grand Trunk, and that the trains passed over the bridge as usual, on schedule time, has been selected for special admiration, which has been expressed in the British engineering journals and elsewhere. Sir Charles Rivers-Wilson has recently, in England, drawn attention to this splendid piece of work, at the same time indicating that English engineering was behind so far as similar work and problems were concerned.

J. A. Macdonnell, chief engineer of the Public Works Department of Manitoba, gives the following summary of railway extensions during the past year, and the proposed extensions of 1899: "The railroad mileage constructed this year is the Dauphin extension from Sifton, 55 miles, the Southeastern to Marchand, 46 miles, Rockwood extension on Stonewall branch, 20 miles, the Pipestone extension to the boundary of the province, 3 miles of track, and 17 miles of grading, Belmont-Hartney extension, 46½ miles, switch connection between N.P. and C.P.R., ¼ mile; making in all a total of 178¾ miles. The probable extensions of next year are: The C.P.R. Pipestone branch from the end of track at present, 50 miles to the Moose Mountains, the continuation from Toulou, the end of the present Rockwood branch to Gimli, on Lake Winnipeg, a distance approximately of 20 miles, extension of the Southwestern to the Lake of the Woods or Rainy river—if the former be chosen, 75 miles; if it be decided to go around the southwest corner of the Lake of the Woods to Rainy River, the length of construction will be in the neighborhood of 125 miles. If the season is favorable about 100 additional miles will be constructed on the Dauphin line, carrying it to the northern limit of the province, and beyond. The construction of the Belmont branch will be continued to Hartney or a point on the Souris river in that vicinity. Other extensions are also being considered by the Northern Pacific, the particular location of which it is not at present possible to indicate."

In an interview with a local journalist recently, J. M. Shanley, C.E., who has charge of the construction of the Atlantic and Lake Superior Railway along the Baie des Chaleurs route, is reported as giving some interesting details regarding the work now being done at the harbor of Paspebiac. The large wharf which is being built at this point by Heney and Smith, of Ottawa, will be, when completed, 1,800 feet in length and 80 feet in width, and will accommodate two steamships of the largest tonnage, besides smaller craft further landward. A large elevator, to have a capacity of 1,000,000 bushels, will be situated near the end of the wharf; this has already been contracted for. The steamers will be protected from all winds while lying in the harbor, where, according to Mr. Shanley, the anchorage is of the best possible kind. Mr. Shanley also stated that what was known as the Baracho's Lagoons would be reclaimed, a work which could be done with but little trouble or expense, and the land in question used as a shunting ground. Six hundred men are at work blasting the cliff which lies between New Carlisle and Paspebiac, and half of this work has already been accomplished. The railway, Mr. Shanley said, was in good condition and the stone work for the new bridge over the Big Bonaventure river was completed and awaiting the superstructure.

Mining Matters.

The Iron Mask Mining Co., Rossland, B.C., has ordered a ten-drill compressor plant.

Gold in Guysborough County is looking up. The mines at Goldenville are working all the time.

A company of Lunenburg, N.S., and Mahone Bay capitalists have been formed to work the rich gold find which has been made at New Cornwall.

A school of mining instruction has been opened at Kamloops, B.C., by A. J. Colquhoun, M.E., who is known in connection with the British Columbia School of Mines. The classes were started January 9th.

J. D. Chipman, who represents the English capitalists now in control of the St. Stephen, N.B., nickel properties, has received a cable message directing him to send forward twenty tons of the ore.—Fredericton Reporter.

The Glencoe Oil and Gas Company, of Glencoe, with a capital of $20,000, has been incorporated, the following being the provisional directors: Geo. Parrott, W. J. Small, S. H. Small, R. J. R. Aldred, A. E. Aldred and Geo. Hay.

The old iron mines at Woodstock, N.B., have been purchased by a Chicago firm, and a tramway will be built to the ore beds. As the ore is well suited for the manufacture of high grade steel, the industry may be a large and permanent one.

L. Sherk, Son & Co., of Hamilton, who are operating the Wallbridge Hematite mine, Hastings County, have contracted to supply 50 tons per day to the Hamilton smelter. The ore is said to be the best shipped to Hamilton, averaging as high as 62 per cent.

B. Kelly, of Ottawa, claims to have made a valuable discovery of gold-bearing quartz in the county of Lanark, about three miles from the Kingston and Pembroke railway. He has purchased the property. Assays taken, he says, far exceed anything known in Eastern Ontario.

The Dominion Coal Company is sending one of its most experienced engine drivers to South Africa to practically demonstrate that Cape Breton coal is excellent fuel for steam purposes. It may be remembered an experimental shipment was made there early in the autumn. There is said to be a large market for steam coal in Cape Colony.

The value of ore produced by the Rossland mines during the year just ended, reached the enormous aggregate total of $2,804,758.12. The shipments were 116,697 tons; for the year ending December 31, 1897, the shipments were 68,000 tons and the value of the ore mined was $2,100,000. In a single year the shipments from the mines were almost doubled, while the value of the output increased $700,000 or 33 per cent. The year has been remarkable for the influx of foreign capital, which absorbed some of the better Rossland properties. First in size comes the British American Corporation, with investments of nearly $5,000,000.

An innovation in treating free milling ore will, it is said, be made by the Oro Fins Mines Company, which has property at Fairview. After careful examination and reports received from some well known mining engineers, the board of directors has decided to put in one of the new Parks amalgamators. This will supersede the old plate method of saving and collecting the gold, and at the same time afford greater protection against stealing the amalgam. It is absolutely impossible to get at the amalgam, as one man, the superintendent, controls the whole machine. The Wm. Hamilton Company, of Peterboro, Ont., and the Parks claim to have effected a combination that will revolutionize the treatment of free milling ores.

Madoc village is the centre of active mining operations. The Review says: The Cordova mine in Belmont, ten miles northwest of Marmora, is being worked under option by a wealthy English syndicate. The mine was formerly owned by Carscallen and Lingham, and latterly by A. W. Carscallen, M.P., of Marmora. The mill of the Canadian Goldfields Company at Deloro will be running in a short time. Work is being prosecuted steadily at D. E. K. Stewart's "Diamond Mine," about six miles east of Madoc. A few weeks ago Meyer Brothers, representing wealthy Belgian capitalists, interested themselves in this mine, and under the direction of Leopold Meyer, mining engineer, of Brussels, Belgium, a three compartment shaft has been put in, building erected for boiler house, and machinery installed for hoisting the ore working steam drills, etc., and it is expected work will be pushed vigorously during the winter.

DISPUTED POINTS IN CONNECTION WITH THE CONSTRUCTION AND MAINTENANCE OF MACADAMIZED ROADS.

BY H. IRWIN, M. CAN. SOC. C. E.

The present paper was written in October, 1893, and was originally intended to be used as a private record of the opinions expressed by several members of the American Society of Civil Engineers during the course of a discussion on the subject before us, which may be found in the transactions of that Society for December, 1892, and February, 1893. The purpose of the paper is to compare the opinions of the engineers who took part in the discussion above alluded to, not so much with a view of bringing forward anything new, which would be almost impossible, but in order to ascertain how far the diverse opinions might be reconciled or accounted for by difference in the local conditions.

The principal points discussed are arranged under the following heads, viz.: 1. Grades. 2. Drainage. 3. Transverse section. 4. The necessity for using the Telford foundation and its construction. 5. The construction of macadamized roads without the Telford foundation. 6. Quality of stone, and the size of the macadam. 7. Blinding material and its usefulness. 8. Rolling—Whether by horse or steam rollers. 9. Repairs or maintenance. The writer proposes to take these up in the order given.

First, Grades.—Mr. Owens states that any departure from an ideal grade of 1 per cent. is to a certain extent to be resisted, and that the minimum grade should never be less than ½ per cent. in order to secure proper longitudinal drainage; and that the maximum grade for ordinary country and general travel should be 4 per cent., which is the limit of an ordinary trotting gait. F. Crowell differs from Mr. Owen as to 1 per cent. being the ideal grade—and states that, in his opinion, if a uniform grade of 1 per cent. can be secured, without undue expense, it is preferable not to exceed it, but that where the road is undulating, with frequent reversions of grade, the horse will do equally well or even better with grades of 2 per cent. He also states that it is well known that horses as a rule travel better on a slightly hilly country than on a dead level. The other members who

*Extracted from a paper read before the Canadian Society of Civil Engineers

joined in the discussion do not appear to have touched on this branch of the subject. The writer would venture to remark that both maximum and minimum grades might be made to suit the class of vehicles most likely to make the greatest use of the road to be constructed, and that the question of cost would have to be considered. In farming districts, where the large majority of the vehicles carry heavy loads and do not go faster than a walk, the maximum grade might well be raised to 5 per cent. and the extra cost of 4 per cent. grades either saved altogether or expended on the road surface. As to the minimum grade, water will flow so freely along a water-table or gutter with a fall of ½ per cent., that a similar grade might well be taken as minimum for long uniform stretches of road, short pieces of level being permitted to break grades or at summits. The fact that horses seem to travel better on undulating roads, where the grades are not over 2 per cent., than they would on the level is probably due to change in the muscles used in ascending and descending; this would apply, however, more to heavy than to light traffic, as a trotting horse, going at a good pace, would find a 2 per cent. grade pretty hard, and would probably travel much easier on the level than on an undulating road, especially if allowed to walk a short distance occasionally. The writer would add that he has often heard drivers complain of a long uphill pull, even when the grade was light.

Secondly, Drainage.—Mr. Owen's opinion is that: "It is necessary at all times that proper and complete provision be made for thorough and perfect drainage of the water from the roadway; this, as well as the necessity of under-drainage in certain specified localities, either by pipes or blind drains, admits of no dispute, when the fact is remembered that one dollar spent judiciously in under drainage will save many dollars as a capitalized fund to meet the expense of repairing badly drained sections of the road." Latham Anderson, referring to the rainy and muddy part of the country east of Central Kansas, says that: "Given an earth road skillfully located, properly shaped for surface drainage, and with the roadbed thoroughly under-drained with tile, say, to the depth of at least two feet, all that is necessary to make this a fairly good country road is to cover a strip in the middle, say 14 to 16 feet wide, with six inches of gravel or shale." Mr. Anderson also recommends the excavation of ample ditches, and using the earth thus obtained to raise the sub-grade above the surrounding ground and the construction of drains under the road surface in all clay or tenacious solid. J. E. Cooper states that: "Telford roads put together with loam and light rolling stand because the water, that will surely find its way through the metal, is drained away through the Telford," and that "the macadam roads put together in the same way will go to pieces because sub-drainage is not provided." W. C. Oastler on the other hand states that: "The suggestion that the earth sub-way being flattened instead of being an arc of a circle causes the drainage to be defective or insufficient is not correct in practice; that the stone road above the foundation will, if properly rolled, be practically water tight, and will preserve itself and the foundation against the inroads of water;" and also says "I do not believe it is worth time or money to make elaborate schemes for under-drainage of broken stone roads. Lateral drains, honey-combed foundations and other expenses for so-called drainage are wasteful excess and generally can be omitted." Messrs. Owen, Anderson and Cooper would thus seem to differ materially from Mr. Oastler as to drainage. On closer examination, however, the difference of opinion may be considerably reduced. All are agreed, of course, as to the necessity of surface drainage. With regard to under-drainage, Mr. Owen states that its necessity in certain specified localities, either by pipes or blind drains, admits of no dispute. Mr. Anderson's opinion evidently is that an earth road should be thoroughly under-drained with tile in order that it might be put into fairly good order with six inches of gravel or shale. Mr. Cooper seems to think that the Telford foundation will act as an under-drain, while Mr. Oastler saves himself from being too dogmatic by stating that lateral drains and honey-combed foundations can generally be omitted. Surely Mr. Owen's statement last referred to admits of no dispute, since under-drainage is an absolute necessity where there are springs under the road surface and in wet clayey soils where the side ditches will not drain the centre of the road-bed. Mr. Anderson's opinion as to earth roads might be modified by stating that in open gravelly soils the side ditches, when not too far apart, may be counted on to drain the road-bed. Mr. Cooper's idea that the Telford foundation will act as an under-drain may hold good for a year or two after the road has been constructed, but the writer does not think that it would hold good for any length of time, as he has never yet seen an old foundation dug up in which the spaces between the stones were not completely filled with earthy material, so that it could not possibly act as a drain. Indeed, even when the foundation was quite new, it is almost certain that the water, on passing through it, would soak into the earth below, unless some special provision were made to carry it off at the sides. Mr. Oastler's scheme for avoiding under-drainage altogether by keeping the surface well rolled would also involve constant repairs to prevent water standing in slight hollows, would probably be more expensive in the long run than under-drainage, and could only be carried out in rich districts. The writer's experience, though rather short, so far as actual practice goes, certainly goes to show that less depth of stone is required on a firm, well-drained road-bed. The approximate distance apart at which drains act might be given: In open gravelly soils, drains from three to four feet deep will act from twenty-five to thirty feet on each side; in such soils the side ditches will drain the road-bed perfectly if deep enough. Where the soil is marly loam, drains will act about twelve to fifteen feet on each side, in this case, unless the road surface is kept in good order so as to throw all rain water quickly into the side ditches, and unless the road-bed be originally dry, as on a side hill, or in embankment, a covered drain would be required along the centre. In stiff clay soils French drains can only be counted on for about eight or ten feet on each side, in which case, if the sub-soil be wet, V drains running from the centre of the road-bed diagonally to the sides may be needed. In making drains, it is well to remember that water will not flow through soil so nearly on a level as it will in an open channel. Drains, therefore, will only dry wedge-shaped sections of ground, and the denser the soil the steeper will be the wedge. The subject of drainage might be closed by quoting Mr. Calvin Tomkins' remarks, viz.: "It is possible by making the road-bed sufficiently thick to ignore a wet bottom, but is cheaper to arrange for a dry base and place a thinner road on it. Drainage is of the first importance, but the cost of drains can be greatly modified by making the surface of the road as nearly water-tight as possible."

Thirdly.—The transverse section of the road-bed and of the foundation. Mr. Owen states that "it is agreed on all sides that the road-bed should be graded to a surface uniform with the finished roadway," and that his practice is to roll the road-bed when no foundation is used, but not to roll it previous to laying a Telford foundation, which he brings to a uniform surface by scooping out the earth below the deeper stones. Mr. Oastler does not agree with Mr. Owen as to grading the road-bed to a surface uniform with the finished road, and prefers to grade it level across; firstly, because it is cheaper, and, secondly, because it admits of using stones of different thickness, the larger stones being placed in the centre. Mr. Oastler also prefers to compact the road-bed by rolling, and does not agree with Mr. Owen's plan of laying the foundation, even by scooping out earth under the stones, as he does not think it necessary that the surface of the foundation should be quite even. Mr. Callanan stated that his practice was to grade the road-bed to a surface uniform with the finished roadway securing good lateral drainage. Thomas Codrington, formerly General Superintendent of Roads in South Wales, after stating that, since timber hauling and other heavy traffic generally takes the sides of a road, gives it as his opinion that it is usually better to form the road-bed with its surface either nearly or altogether parallel to the finished surfaces so as to have a uniform or almost uniform thickness of metalling. Mr. Codrington also states that this method of formation is attended with the advantage that a dry formation surface is prepared for the road materials.

The writer thinks, therefore, that it might be fairly concluded that where there is likely to be heavy traffic extending over the entire width of the road the road-bed should be graded either exactly, or almost, parallel to the finished surface, and that this method of grading the road-bed will help

to keep it dry during construction, but that it cannot be counted on for drainage purposes for any great time after the road has been finished; but that, in the case of roads for lighter traffic, which should of necessity be cheaper, the road-bed might be made flat, and the crowning of the finished surface obtained by making both the foundation and the macadam thinner towards the sides. As for the completed surface, in the district of which the writer had charge in Ireland, the usual rule was to raise the centre above the sides at the rate of one inch per yard of width from the centre to the side, the slope being steeper at the sides than in the centre. Mr. Owen states that for a sixteen-foot roadway, an average crowning of four inches is desirable, which is at the rate of one inch in two feet from the centre to side, or a grade of one in twenty-four. The other members who took part in the discussion did not question the statement. Mr. Codrington's opinion is that the fall from the centre to the sides need not be more than six inches on a thirty-foot road, or one in thirty from centre to side, and should never exceed nine inches or one in twenty; and that for a road eighteen or twenty feet wide three or four inches, or from one in thirty-six to one in thirty is enough. He also remarks that, if the surface be neglected and allowed to wear into ruts, no amount of convexity will clear the surface of water. This latter statement can be fully endorsed by the writer, who saw a gravel road last winter, about fourteen feet wide, in the centre of a sixty-six foot road allowance, and raised about two feet above the level of the water tables at the edges of the sidewalks, the water tables being quite dry, and yet the roadway, which was badly rutted, was full of water, and amost impassable. Had this road been well harrowed and rolled, it might have been kept in good condition. As there was no discussion on this subject, it might be taken for granted that on the level, or on easy grades, a fall of from one in thirty to one in thirty-six is sufficient, and that on hills the slope from the centre to the sides might be from one in twenty to one in thirty, and that it is useless to try to make higher crowning take the place of an even surface for transverse drainage.

(To be continued).

—"The G. A. Robertson" catch basin and tap, described in our November issue, is already receiving substantial recognition of its merits, the Montreal Pipe Foundry Co. having had an order from the Corporation of Westmount, Que., for 50, which are now in position, and giving complete satisfaction.

—Owing to the increased demand in Canada for the Norton Ball-Bearing Jacks, A. O. Norton will enlarge his plant at Coaticook, Que., and equip it with special machinery. Export business will also be handled from this point, shipments having recently been made to Japan, South America, Hawaiian Islands and New Zealand.

—This primitive conveyance seems rather to mock the improvements of the age. A horse railroad, about a mile in length, accommodates the residents of a suburb of San Francisco. The grade is about 3½ per cent. A horse draws the car and passengers uphill, the car descends by its own gravity, and then carries the horse on the rear platform of the car. The ascent is made at the rate of 3½ miles an hour, the descent is at the average rate of 15 miles an hour.

—The Hamilton, Ont., Blast Furnace Company has decided to install a steel plant in connection with the blast furnace at once, and employment will be given to a large number of skilled workmen. When the blast furnace was proposed, the city passed a by-law granting a bonus of $65,000 and an additional sum of $60,000 was to be granted if the steel works were in operation within a certain time. The latter bonus lapsed, but the company does not intend to ask any further favor from the city.

—George Waring intends going to Quebec to erect and drive into the woods a novel machine for hauling logs on the snow by steam power. The machine is made in Michigan and is to be sent by rail to a station on the I.C.R. east of Levis, where Mr. Waring will put it together and drive it about seventy-five miles to its place of operation in the forest, on the head waters of the St. John river. George Cushing of St. John is the enterprising lumberman who is starting this new method of handling logs in the woods. The weight of the machine is upwards of twenty tons. It is said that several of these engines are operating about Winnipeg and in the western States. This new departure will be watched with interest.—St. John Sun

—It is probable that for the first time in our history the United States will this year be surpassed by Russia as a producer of petroleum. Reducing the totals to the common standand of metric tons, we produced in 1897 a total of 7,708,236 tons, while the quantity reported for Russia was 6,919,000 tons. For the first half of the present year, however, according to Russian official figures quoted by The Chemiker Zeitung, the output was 3,993,300 metric tons, which points to a total for the year approximating 8,000,000 tons. The output of the United States for 1898 will not differ greatly from that of 1897; if anything it will be somewhat less, so that we may expect to fall to the second place.—The Engineering and Mining Journal.

—A burnished finish on the journals of axles for railway carriages and locomotives has given good service, and has been used on many roads for a long time, says The American Engineer. The advantage of it is to smooth the surface of the journal after the finishing cut, and to shorten the period of breaking in. The burnishing is done by three rollers carried on a tool rest and bearing against the journal, considerable pressure being obtained by a screw. The rest is fed along so that the finishing cut and the burnishing are done at the same time. Mr. Atkinson, of the Canadian Pacific, uses the burnisher on piston rods, and intends to use it on valve rods, as well as on journals. He stated, at the recent Master Mechanics' Convention, that it gave the best finish that he knew of for piston rods.

—Although so recently brought to the notice of the South African public, the adoption of acetylene as an illuminant is making steady progress. It is recognized that there is a distinct field open for it in South Africa among the smaller towns, and in the suburban districts of larger towns where paraffin or candles are still the chief illuminant. At the present price of imported carbide, £32 to £36 per ton in Johannesburg, acetylene gas shows no economy over the electric light, but with the cheapening of prime cost and the lowering of freights—and we understand that the German-Australian Co. has now consented to accept it at a slight additional charge over ordinary cargo rates—a reduction in cost may be eventually effected that may lead to its competing even with the electric light. In the case of the manufacture of calcium carbide being undertaken in South Africa, the reduction in cost which would follow would enable it to successfully compete with all comers.—South African Mining Journal.

—The report of the James' Bay Railway commission, appointed by the city of Toronto, was handed to the City Council at its last meeting for 1898. The commission has embodied in the report not only the information obtained by the expedition sent out to examine the country along the route of the proposed line, but also deals with the question of Toronto's transportation facilities, with special reference to the proposed Collingwood Air line, the harbor improvements, the Sault Ste. Marie and James Bay Railway, and the connection at Scotia with the Parry Sound road. The conclusions arrived at by the expedition, which were conducted under W. T. Jennings and Major Villiers-Sankey, city surveyor, are as follows: That a new line from or near Toronto, Barrie, or Waubaushene north to or near Sudbury, etc., would open up a new section fully as good as that between Gravenhurst and North Bay, and that such a line would shorten the distance to Winnipeg by fully fifty miles; that a new line in the meantime from, say, Verner, northeast to Temogami Lake, would be of immediate benefit in developing that large section in its very near future; that a line from North Bay to Temogami and north to the Blanche river country, a hundred miles, would make an available outlet for the lands and forest products of these regions, including the extensive valley of the Montreal river; that a through line to James Bay should be constructed by way of the last named route; that the ultimate extension of the line from the divide to James Bay is a matter for future consideration.

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FOR THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

PART II.

CHAP. I.—TRACK.

ARTICLE 1.—FORM OF ROADBED.

The first essential of a good track is proper drainage; there can hardly be good track without it, from which it naturally follows that too much care cannot be taken in forming a roadbed at the completion of its construction, which will have good drainage in itself; even with abundant and good ballast, drainage is necessary, while it may be the saving feature of a track surfaced with inferior or scanty ballast. Plate XXII. shows types of roadbeds in use in America, and it will be seen that most of them have a slight slope each way from the centre, forming a rounded surface onto which the ballast is laid; the crown at sub-grade should be 3 to 4 inches for a single track in cutting, but may be partially omitted on embankments, as future settlement tends to round off the corners and aid drainage. Should low spots exist in the centre of the roadbed beneath the ballast, water will lodge there and soften up the earth so that the ties will sink under the churning action of car and engine wheels. Although not essential or always done, it is an advantage and an economy of ballast to elevate the roadbed on curves parallel to the expected plane of the ties and rails; this practice also gives an elevated track before ballasting is commenced. Widths of roadbed vary with the climate and materials. Embankments vary from 10 feet for cheaply built roads in the Southern U.S.A. to an ordinary standard of 16 feet for Canadian and Northern U S.A. first-class roads; cuttings vary similarly, but are usually about 6 feet wider than the embankments for making ditches; for purposes of handling snow it is not found advisable to make cuttings less than 22 feet in Canada, although rock cuts with narrow ditches are sometimes made 20 feet. To all of these, 12 to 14 feet are added for each additional track, and in case of very wet cuttings extra width may be needed for proper drainage (see Fig. 8, Plate XXII.), or a tile may be laid beneath the cut ditches to drain the sub-soil (see Fig. 5, Plate XXII.). Ordinary cut ditches are about three feet wide and one foot deep, and may be wedge-shaped (Fig. 7) or trough-shaped (Fig. 8), but although the latter is often dug in the first place, the weight of evidence is in favor of the former, which is formed by a flat slope of from 2 to 1 to 6 to 1, starting from near the edge of the ballast and meeting the cut slope at an angle. The tendency of such a ditch is to direct the water well away from the track and thus prevent undermining of the ballast. Cut ditches should be led well away from the mouth of the cuttings to avoid scouring the foot of the adjacent bank, indeed, the cut ditch on the upper side should join the catchwater ditch and continue down to the entrance of the nearest culvert as a berme ditch placed five or six feet away from the foot of the bank. By a thorough system of ditching at the conclusion of construction much trouble and expense can be avoided and the energies of the track gangs during early maintenance may then be devoted to other things. To make the ditching system complete, catchwater ditches should be dug along the upper side of every cut, placed six or eight feet back from the top of the slope, the earth from them being placed inside; these ditches should collect all those small trickling streams and general hillside wash that would otherwise run down the cut slopes, carrying sediment into the cut ditches. These cut ditches are often soon neglected during early maintenance, and extra ties, heaps of unused ballast and stray boulders block the drainage, while in later years rotten ties and weeds need watching. Too great stress cannot be laid on having clean straight cut ditches with a uniform fall.

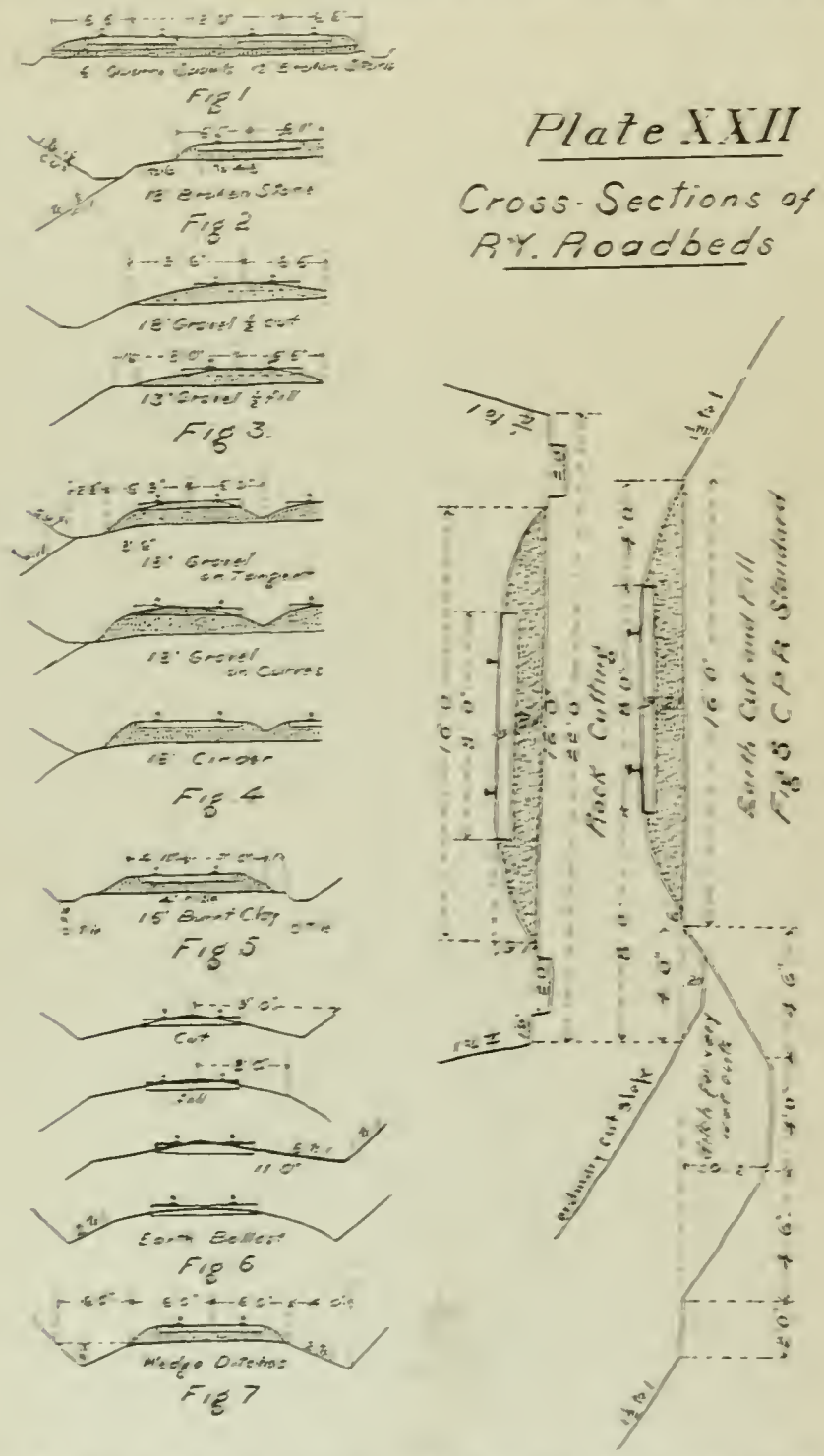
Of late years construction has been usually very rapid, and embankments, if made of earth, will rarely have completed more than half of their shrinkage; this will vary in amount with the method used in building the bank, being greatest when built with wheelbarrows or machine graders from side ditches, and least when flat or wheel-scraper work has trampled it in thin layers by the horses' feet, etc. For these reasons all banks made of earth ought to be left full width and a certain per cent. of height at each point above the theoretical grade line. Of course, abrupt changes in track surface are not desirable, even for a short time, and such allowance for shrinkage should be made with judgment according to the merits of the case in hand

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

at each point bearing in mind what the ballast is costing, the expense of re-lifting sunken track and the large amounts of extra high-priced material needed if this allowance for shrinkage is not made before grading is completed : on page 150 the per cent. of shrinkage of different materials is given, which will serve as a basis for estimating how much extra height should be given to the banks : if construction has been completed in one season at least one-half these amounts are necessary.

ARTICLE 2—BALLAST.

The quantity of ballast used is a purely financial question, and up to a usual limit of 12 inches underneath the ties, the more the better, can track be maintained for the same cost : 12 inches under ties takes about 3,000 cubic



yards per mile : 6 inches under ties takes about 1,800 cubic yards, including filling around ties as in Fig. 8, Plate XXII., but with no allowance for sunken banks and extra material. The functions of ballast are :

(1) To afford lateral, longitudinal and vertical support to the ties sufficient to keep the track in line and surface without incessant track labor.

(2) To carry off all water as rapidly and thoroughly as possible after rain storms or thaws.

(3) By drainage to lessen the action of frost in heaving track during the winter and spring.

(4) To give elasticity to the roadbed.

The following materials are used more or less extensively for ballasting and are given in order of merit as nearly as may be :

(1) Broken stone to a 2-inch ring ; coarser underneath.
(2) Furnace slag and cinder.
(3) Coarse, clean gravel.
(4) Broken bricks or any form of very hard burnt clay.
(5) Sand not so light as to be easily blown away.
(6) Earth, usually compact clay, seldom loam.

Broken stone ballast, although expensive and hard to tamp and surface with, gives the most durable and satisfactory track with least labor for maintenance ; only roads with heavy traffic can afford to have it, as it costs from 75 cents to $1.25 per cubic yard in place. When used, it is generally flush with the top of the ties for about 1 foot beyond their ends, thus giving lateral support, and side slopes rather steep (about 1 to 1). A very finished appearance can be given by laying a margin of stones to line by hand, and keeping the rest of the roadbed, outside, free of ballast and grass. The slag from blast furnaces, if properly cooled and broken, makes a very good and durable ballast, but its use is evidently limited in area and the price will vary according to circumstances ; cinder also is a valuable ballast, but limited in quantities. Probably gravel may be looked on as the ballast more generally used in America than all other forms combined, because of its wide distribution and general utility. When clean and fairly free from sand and large boulders, it drains well, surfaces easily, and holds track from all but lateral movement : in this it is deficient as it will not stand steep enough to admit of the ends of the ties being fully submerged, unless a very wide roadbed is used. (See Figs. 3, 7 and 8, Plate XXII.). The cost of gravel ballast in place varying with length of haul, may be put at 15 cents to 20 cents per cubic yard if loaded with steam shovels from a good pit and unloaded by ploughs, but will run as high as 40 cents when material is manually handled from pits with heavy stripping. In all cases the stripping of pits should be attended to, and all inferior material wasted or put on low or narrow banks. The ballast material should be of a uniform quality, as any patches of loam or clay mean just so many sunken spots in the track.

Sand ballast creates dust in summer which injures the rolling stock, does not hold a track well to surface or in line under heavy traffic, and has a tendency to hold water and heave track in the spring : unless very coarse it is not at all a good investment if other ballast can be obtained. In such situations many roads have resorted to burnt clay or broken brick, but unless well and uniformly burnt, almost to vitrifaction, it is not a very durable material. In mild climates, such as Southern U.S.A., many railways have ballasted with clay taken from ordinary cuts, either from the cut slopes or hauled by train from the nearest point. If the clay is of a compact nature, and such a cross-section as one of those in Fig. 6, Plate XXII. is used, it will soon get beaten down and shed ordinary rains without any water permeating the roadbed. It is evidently a very cheap way to ballast, and in the absence of other cheap materials may be very justifiably used in such climates by roads of light traffic and meagre resources. Except in the case of broken stone, laid with teams, from adjacent fields, the ballast is put on, after the track is laid, by train loads, and, in so doing, unless the newly laid track is at once roughly surfaced, and trains run very slowly over it until a light "lift" is first put on and the track fairly well lined and surfaced before the ballast trains are allowed to run at a high speed, we may expect permanent injury in the form of bent rails and cracked angle bars, especially as the track is often not fully tied, spiked or bolted. In surfacing and lining track it is well to remember some general principles applicable to all materials and at all times.

(*a*) The coarser material available ought to be put underneath, *i.e.*, on the first lift.

(*b*) When the supply of ballast is limited and subgrade sunken on the banks, it is better to be satisfied with a track having local depressions below the theoretical grade line, rather than to rob the sides by building up a high, narrow track to the true grade, as such a track will soon sink and get out of line—being deficient in lateral support.

(*c*) Each tie should be tamped equally well, because even one tie, without support, acts like a force pump: each passing truck, by suddenly depressing it, compresses the air under it, forces out more ballast, until there is a cavity formed, a lodging place for water and a permanent sag in the rail.

(*d*) Ballast should be tamped more firmly under the rails than under the centre of the track, because a centre bearing will cause a rocking motion which will increase rapidly, especially on banks, where the sides are apt to sink more than the centre anyway.

(*e*) Surface is rather more important than alignment, although not so easily obtained or seen by a track foreman.

(*To be continued*).

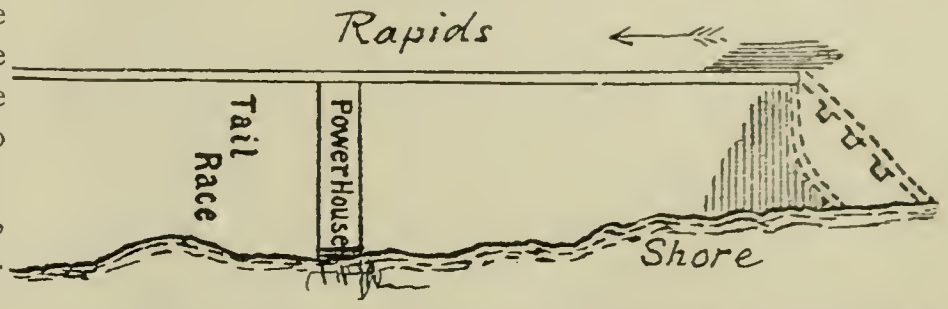
FRAZIL ICE IN THE LACHINE RAPIDS.

The Lachine Rapids Land and Hydraulic Company has been supplying electric current steadily to Montreal since last winter and has had four dynamos running, delivering 3,000 h.p. Some difficulty was again experienced, during the severe weather early last month, in obtaining a sufficient head of water to keep the plant in operation. The lighting companies subsidiary to the Lachine Rapids and Hydraulic Co., the Imperial and the Temple Cos., had to start up their steam plant, and the Imperial borrowed a dynamo from the Royal Electric Co.

The two chief difficulties in the problem of maintaining the head which the engineers of the Lachine rapids development had to contend with in winter were the sudden and very great fluctuations in the river level below the rapids, caused by ice jams in the river and the formation of frazil ice. It has been found that the changes in the river level at the city are not so important as was anticipated, but a great deal of trouble has been found through the formation of an ice dam on the rock bottom of the shallow stretches immediately below the tail-race. On the occasion referred to, we are informed, the level of the water in the tail-race rose ten feet owing to this cause and for a time the head was reduced to three feet. The removal of the rock in the shallows below the tail-race will probably remedy this defect, and it becomes only a question of how much the company is prepared to expend in securing itself against similar occurrences.

The second difficulty, that caused by frazil, is as yet unsolved, and if the report is true that the company intends to install a steam plant in Montreal as an auxiliary, capable of running all the arc lights in the city, it would suggest that the final solution was believed by the company to be still remote.

The recent obstruction of the intake which reduced the level of the water in the head race from nine to five feet, as we are informed, was due to the existence of frazil. The construction of the intake will be seen at the top of the accompanying rough diagram, which we reproduce from the Montreal Witness. Between the pier head and the shore are placed in a slanting line three rock-filled caissons, and along the upper side of these represented in the illustration by double dotted lines is stretched a boom thirty inches deep. A little lower down is a second boom represented by the lower pair of dotted lines. This latter is four feet deep. Between these two booms is maintained an open sheet of comparatively still water. These were constructed so that the frazil floating down the current would be stopped by the first boom and carried away by the current which sweeps along it. Should any get past this boom the clear space of quiet water was maintained for it to rise in, and the second boom constructed to catch it. The vertical shading in the illustration shows where a part of the construction dam has been left. Though this does not come up to the surface it is so near it that pieces of ice catch in floating over it. This obstruction lessened the current sweeping the outer boom and also caused a large eddy. In this way the frazil was not carried off as it



should have been. The snow also, which fell heavily at the time, drifted into the open space between the two booms, formed slush, and this getting under the boom rose again immediately and froze to the underside of the ice. Thus between snow and frazil the intake became frozen solid from top to bottom over the area shown by the horizontal shading. This had to be blasted out. To prevent a recurrence of the snow difficulty, a snow fence has been constructed across the ice below the intake. The Witness states that, to prevent the frazil coming in, a few feet will be removed from the top of the old construction dam so that ice may pass over it freely and the outer boom be continually washed by a swift current.

There can be very little doubt that if any solution of he difficulty can be reached, the engineering staff of the company will arrive at it. It has been established that frazil does not form in ice-covered water that is warmer than the open stretches, and frazil is only formed in water whose temperature is below freezing. The vast amount of the St. Lawrence which is kept open by the rapids and swift currents materially cools a large body of water, and this is especially true of the river at Lachine, where for a distance of about six miles above the company's works the river is almost entirely open. In these open rapids frazil is formed in great quantities, and it is yet to be shown that at the bottom of such an extensive stretch of rough open water there can be maintained a sufficient area of still water by which the turbines may be driven and from which the frazil coming down the river can be excluded.

ROPE TESTING.*

BY GEO. A. M'CARTHY AND ERNEST G. MATHESON.

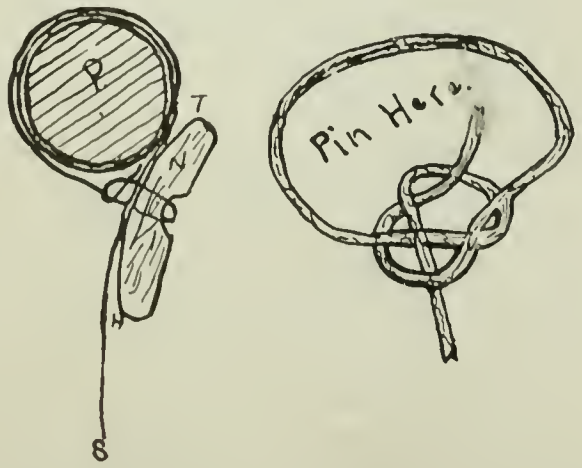
Almost all departments of engineering have been so thoroughly exploited that wherever you may carry your researches you find that you are by no means the pioneers. If this leaves less room for originality, yet it furnishes many useful hints in regard to methods to be pursued in order to obtain the best results with the least effort and in the most satisfactory manner. In our investigation of the strength and other qualities of ropes, it was assuredly not in the multitude of data, but in their absence, where lay our chief difficulty, or if these data existed we failed to get them within our reach, therefore, in so far as we are concerned, this thesis is almost wholly original.

Before entering on the subject of rope testing it might

*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in THE CANADIAN ENGINEER.

be well to glance for a moment at the method of manufacture of the more ordinary kinds. In making the strand of the rope, the proper number of yarns are passed through a register plate, and from that into a tube into which they fit very tightly. This bundle of yarns is then fastened to the forming machine which travels backward down the walk, pulling the yarn through the tube and at the same time twisting the bundle of yarns into what is called a strand. The angle of this twist is in all cases as nearly as possible 37°. Three of these strands, having been hauled the whole length of the walk, are thrown over upon the laying track and each hooked on to a separate spindle of the laying machines which stand at each end of the walk. One machine is stationary and the other travels a little when the twist goes into the rope. This is on account of the rope shortening as it gets twisted. To prevent this machine moving too quickly, a brake is arranged to grip the rails. When the strands are thus hung upon the machines, at each end of the walk, each strand on its own spindle, and the brake in position, both machines are started so as to put more twist into the strand. This turn or twist of course reduces the length and the twist is regulated by the amount the strand is shortened. If 100 fathoms of rope is wanted with 6 per cent. of hard in it, 6 fathoms of hard is put into the strands, after the strands have first been formed at an angle of 37° as already mentioned. In other words, a strand, which has already been formed at an angle of 37°, is taken and twisted by these machines until it shortens say 6 per cent. of its original length; then we have a strand with 6 per cent. of "hard" in it. Generally speaking the hard ropes wear best, but are very difficult to handle in water. The soft ropes are much more pliable and easier to handle, but they do not stand wear as well as the harder qualities. The soft ropes are usually the stronger.

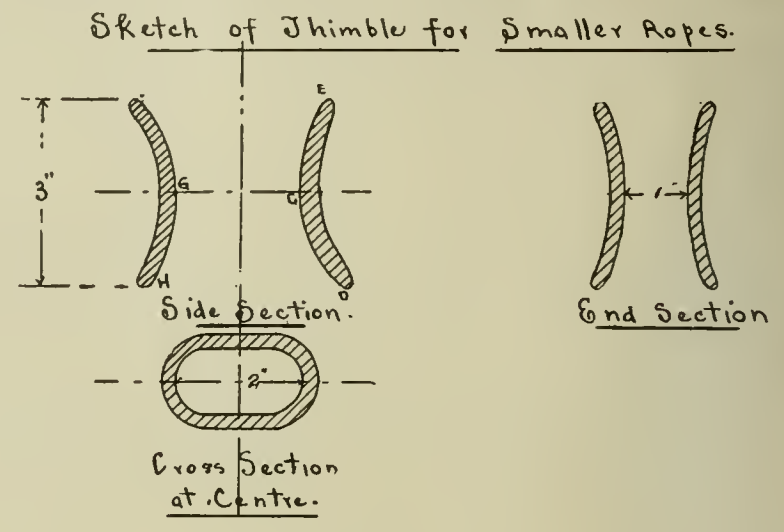
With this brief account of the process of manufacture we will now proceed to describe the testing of the ropes as carried out in the laboratory. At the very threshold the difficulty of holding the specimens was met. Wooden and iron specimens can be so formed that the portion gripped by the testing machine will be sufficiently strong to hold the specimen until fracture occurs in the test piece in the position desired. It is not so, however, with rope. Moreover, it is obvious that even where the rope is made fast round a pin of considerable diameter, some of the fibers will be strained greatly more than others, thus preventing the results obtained from being the ultimate strength of the material. It was this strength we desired to obtain, although it may seem that results gotten under conditions which obtain in actual practice might be more valuable. We desired comparable results and to this end the ultimate strengths are the most serviceable.

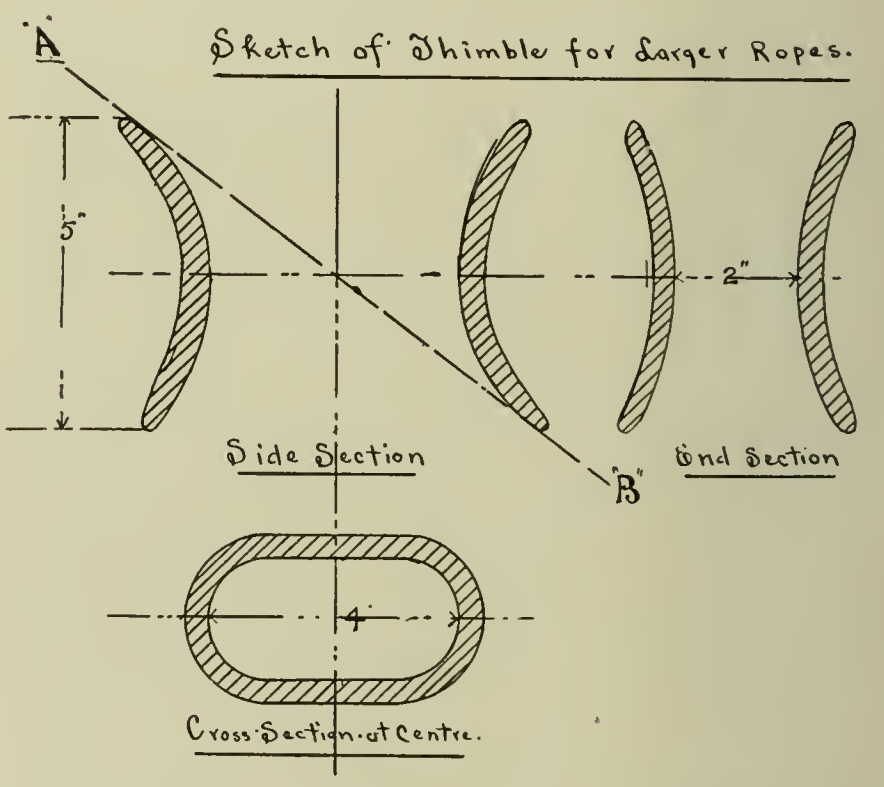


Much difficulty is usually found to hold ropes by means of knots when great stress is applied. By means of the "bowline" knot, a sketch of which is given, we overcame this trouble.

There was no slip nor give; but we soon saw that the strength of the rope was by no means fully developed. The rope failed invariably at the knot, so we were compelled to have recourse to some other contrivance. Splicing was, after consideration, rejected as requiring more time than we had at our disposal.

A contrivance as shown in the sketch below was tried





with some success. P is the pin of the testing machine; N is a block of hard wood. A groove is cut in this along the circular face, TH, in which the specimen to be tested, S, lies. The line, S, goes round the pin twice and is then taken to the block, N, and tied around it, also enclosing the rope, S. The friction of the rope on the pin so decreased the pull on the end tied round the block that the knot on the block never once failed to hold. On account of the difficulty encountered in holding the direction of the block parallel to that of the rope, the device was abandoned. We had the satisfaction, however, of seeing the specimens tested in this manner break in the free, straight portion and not at the fastening. Failure was a successful tutor. We began to clearly perceive the principles underlying a satisfactory holder, and we next tried an oval shaped thimble with flaring ends which were open. The idea was to obtain a holder which would not injure the fiber of the rope; which would not occasion any sharp bends in the strained portion, and at the same time would leave the specimen free to move in the direction of the stress. The thimbles answered very well indeed. The following is a description of them which, with the accompanying sketch, will clearly exemplify the method of working.

The thimbles were made of iron, the smaller about $\frac{1}{4}$ inch thick and the larger $\frac{3}{8}$ inch thick. The dimensions were as shown on sketch. It will be noticed that the radius of curvature along the surface, CD, is the same as

that along FG. The radius along CE being also same as that along GH. The radius along CD and FG is less than that along CE and GH. The fact that the thimbles when in use would not remain in a vertical position rendered this feature of the design necessary, so that a line joining the two extreme corners would be tangent to the curve where the line entered and left the thimbles, as

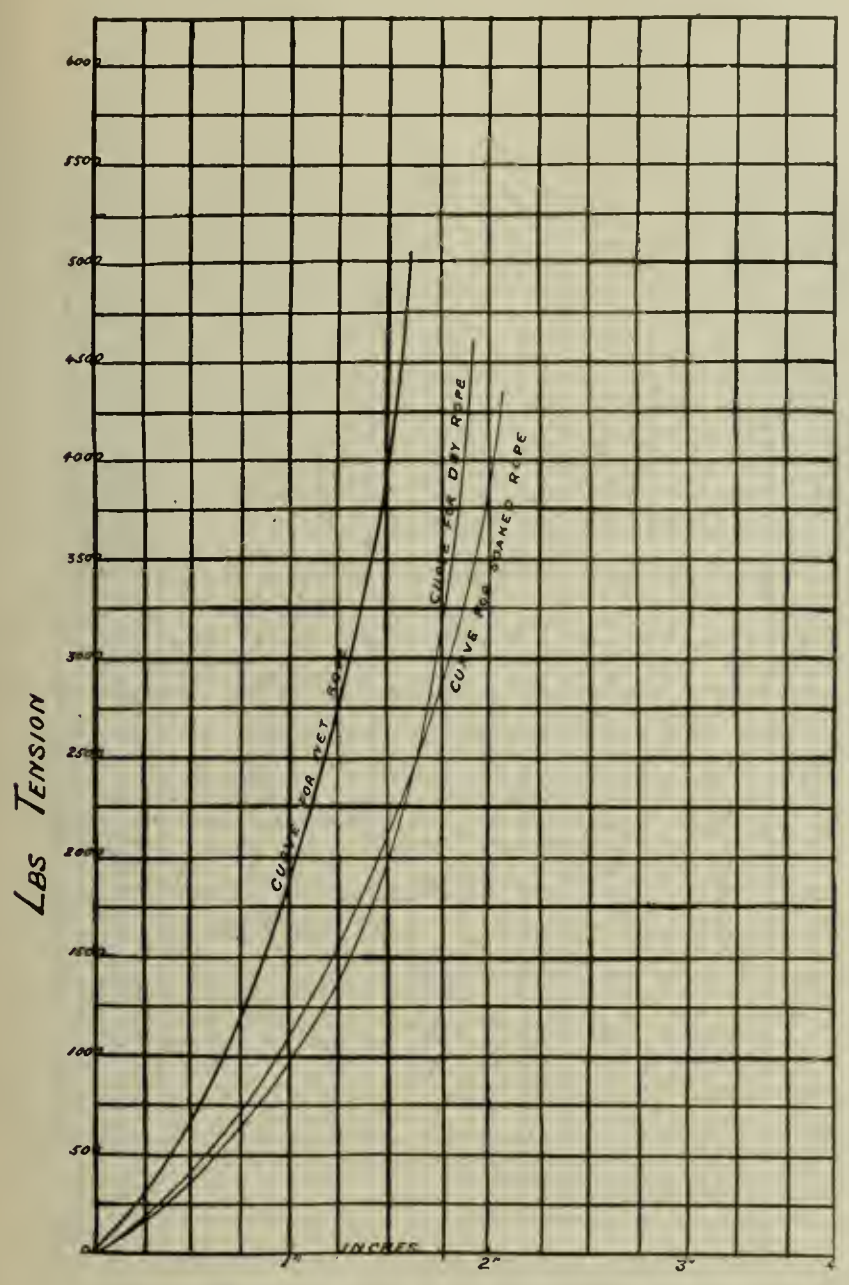


DIAGRAM SHOWING RELATION OF EXTENSION TO LOAD
— FOR —
MANILLA AND HEMP (TARRED) ROPE

AB. When this was the case a rope could not possibly be injured by the curve of the thimble, although the great pressure, even of a smooth surface against the strands of the rope, might possibly crush the fibers to some slight degree. The method of securing the rope was as follows: The free end of the rope was put up through the thimble, passed completely round the pin and brought down again through the thimble. The end was then tied with one or two knots to a short piece of piping about one inch in diameter. This piping reached across and rested against the lower end of the thimble, thus preventing the end of the rope from passing up through the thimble. It was found that, on account of the friction of the rope against the pin, one knot of the rope on the toggle was quite sufficient to hold it. In fact in some instances there was not sufficient rope to tie one knot around the toggle. When this was the case the rope was unstranded and the toggle inserted between the strands and the strands tied around it; even this method of making the fastening never failed.

The Wicksteed testing machine—a machine of the balance type—was the one used. The total range of the machine for ordinary work is about three feet. This was, however, found inadequate for our work owing to the excessive elongation of the rope, especially when wet, and we were compelled to dismantle the machine to some extent. The part C and the corresponding part together with the vertical rods D, P, E, F, (see accompanying illustration) were removed, leaving the pins B and A with their eyes surrounding them. This gave a range of about five feet six inches, which in a solitary instance was not enough. The vertical rod, G, with a corresponding one opposite to it connect the crosshead, J, to both a hydraulic and an electric motor, the former for heavy work where speed is not a desideratum, and the latter for more rapid work where power not beyond 5,000 lbs. pressure is needed. The range of the hydraulic ram was about 10 inches. This was needed whenever the power exceeded 5,000 lbs. When the test was begun the crossheads were usually about two feet apart; yet the distance between them often reached 5 feet 6 inches before rupture. The pins were about 3 inches diameter, and the rope was usually placed twice on the pin in order to increase the friction.

The method of getting the extension was as follows: Owing to the great stretch of the rope no extensometer could be employed. The unequal give at the different ends excluded the setting up a scale beside or attached to the specimen. Workings on the surface were debarred by the want of definition. Fine, smooth tacks were inserted

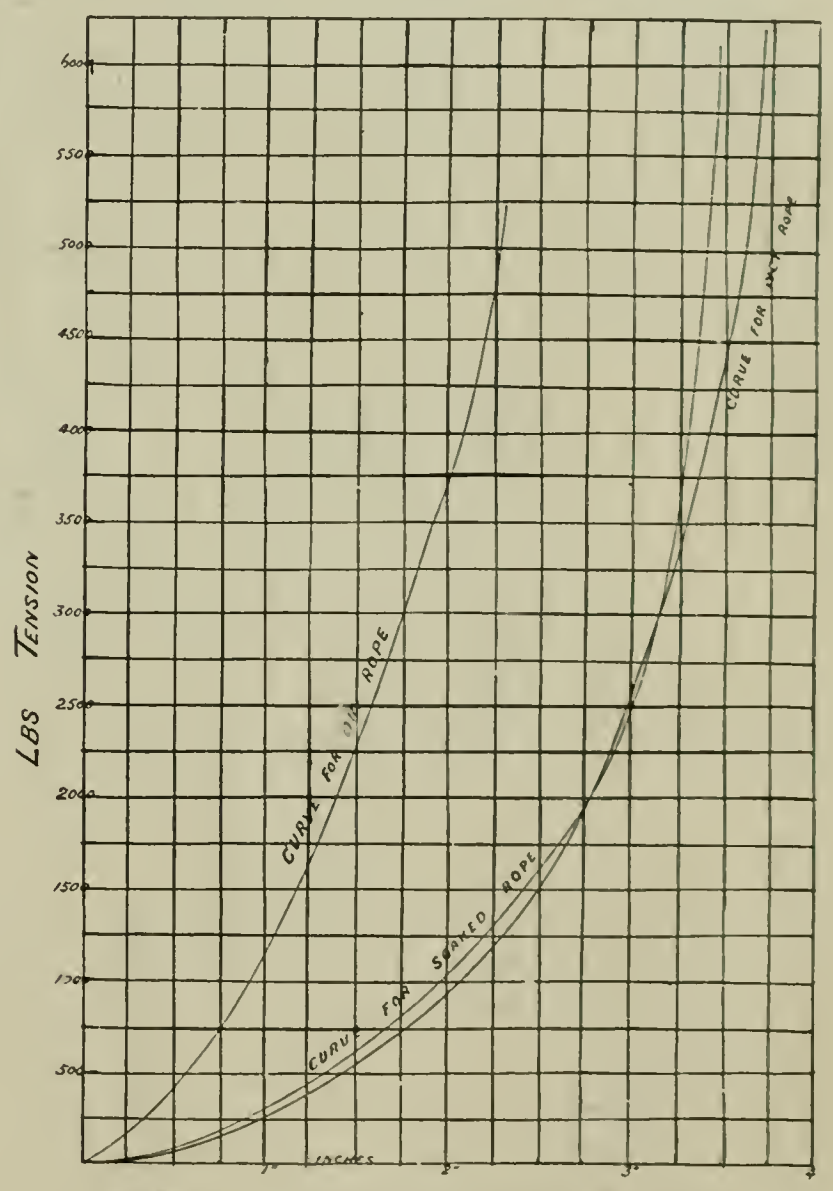
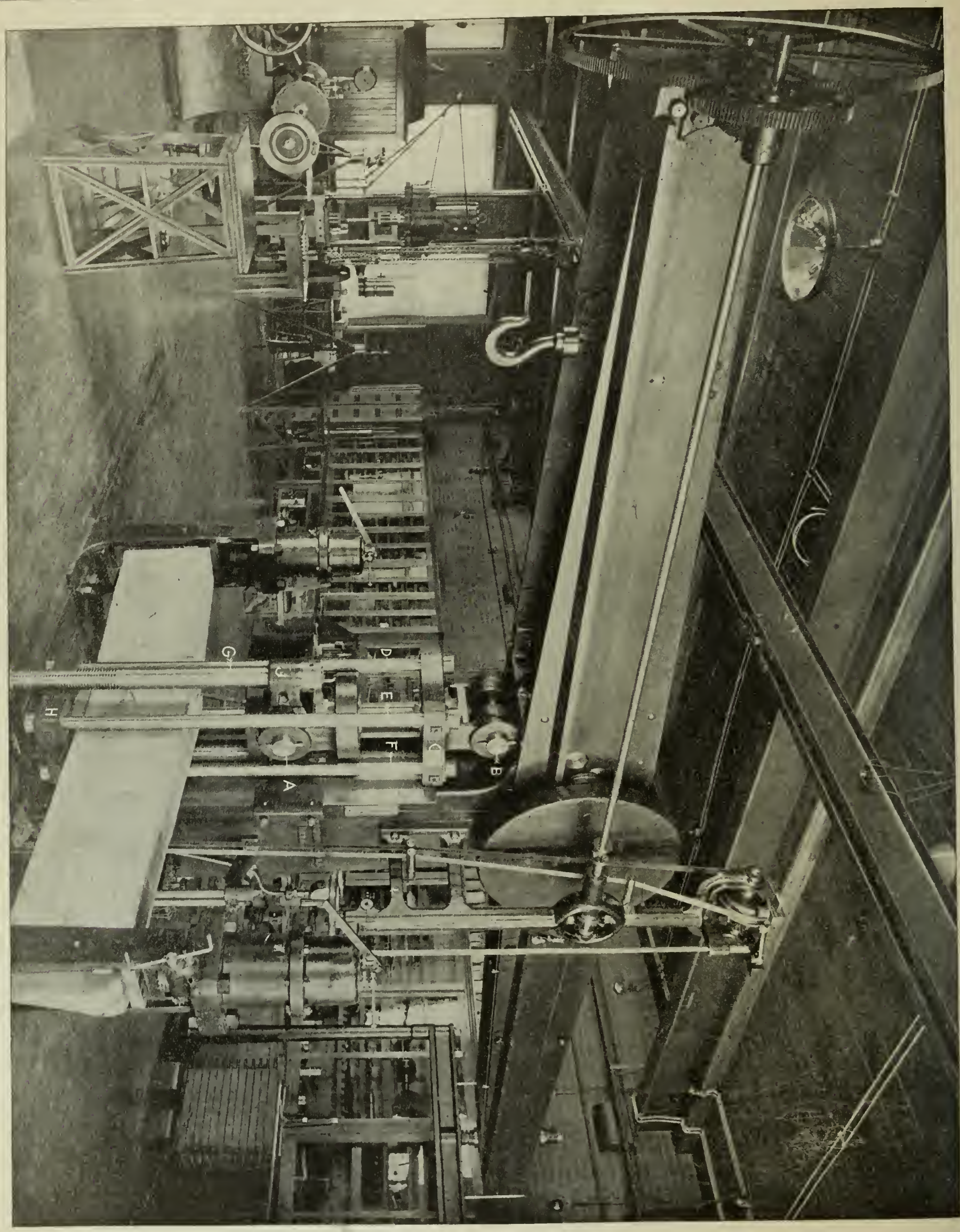


DIAGRAM SHOWING RELATION OF EXTENSION TO LOAD
— FOR —
MANILLA AND HEMP (UNTARRED) ROPE

in the rope at the required distance apart. The distance could be conveniently measured, and we hoped this was a final arrangement, but here again we were doomed to disappointment. Incredible as it may seem even these very small tacks caused the rupture to take place at the points of their insertion, as the tabulated results will show. A very convenient and easily adjusted device was finally employed. It was the adaptation of a contrivance based upon the principle of the pinch-cock to our work.

SHRINKAGE.

The percentage of shrinkage for the different kinds of



rope under different degrees of saturation is given in the following table :

Kind of Rope.	Time Immersed 2-6 days.	Time Immersed 6 weeks.
Manilla	5.0 per cent.	5.7 per cent.
Tarred manilla.....	2.0 "	2.8 "
Manilla bolt rope.....	6.9 "	6.0 "
" " yarn.....	3.5 "	6.2 "
" yarn.....	5.5 "	7.6 "
Sisal	5.7 "	7.6 "
Tarred hemp ratline	6.7 "	8.0 "
" " bolt rope	6.6 "	7.9 "

The table speaks for itself. It will be seen that the rope shrunk more when immersed for six weeks than when immersed for one week. The wetting had not such an effect in this direction on the tarred as on the untarred specimens. The above results are averages. In the same kind of rope there was some variation owing, no doubt, to the many factors entering into the work which tended to make the results not uniform. The principal one of these was the probably unequal tension put on the rope when measuring, dry and after soaking. The tension should have been measured with a spring balance to get the best results. On account of the ropes having to be immersed in a coiled position (the smallness of the trough at our disposal preventing them being laid out at full length) it was

found almost impossible to thoroughly straighten the larger ones after wetting without putting them under considerable strain. This fact would tend to make the percentage of shrinkage less than it otherwise would be.

(*To be continued*).

For The Canadian Engineer.

A SYSTEM OF PLUMBING.

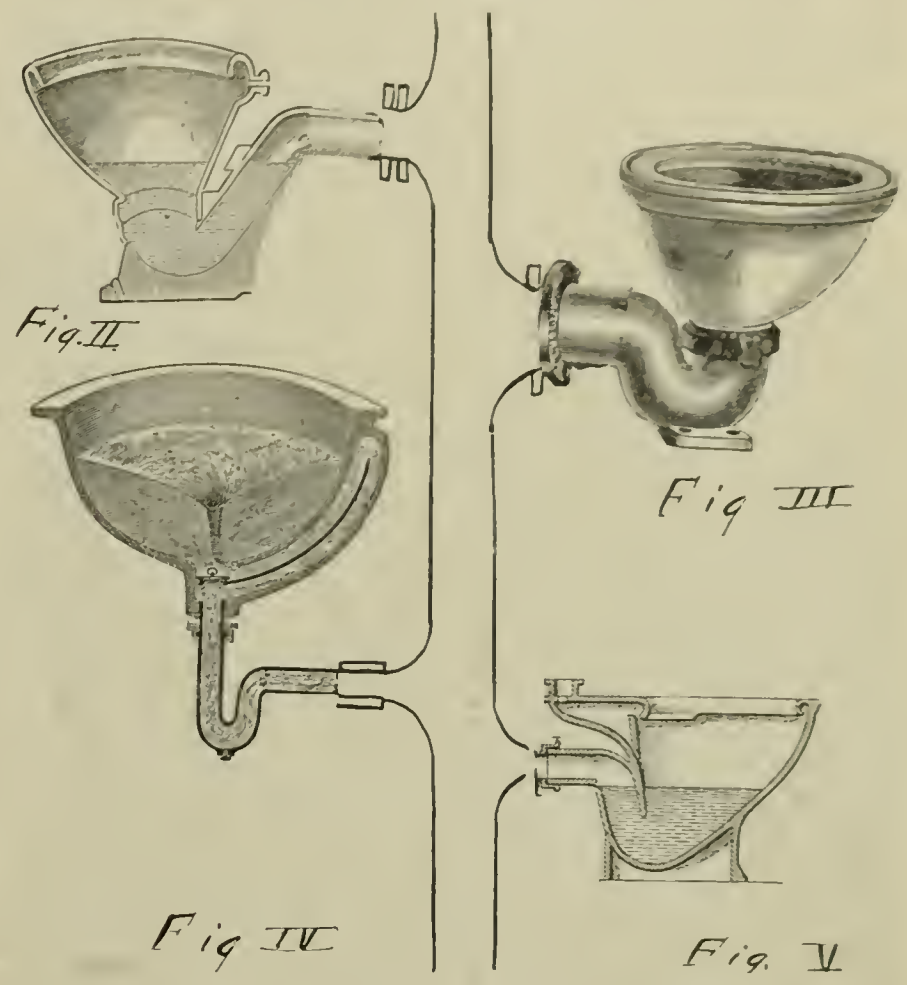
BY W. M. WATSON, TORONTO.

For upwards of two years articles dwelling on sanitary appliances have appeared in the columns of The Canadian Engineer, and its readers will more readily understand the arguments used in this paper if they have read the articles in previous issues. I have shown that such sanitary appliances should always be plain and easy to repair and understand ; that the excesses adopted lately in constructing plumbing appliances and public sewers by some professional sanitary and municipal engineers, is dangerous to the public health, and unnecessarily expensive.

In a former article on sanitary appliances, I stated that the plumbing and sanitary arrangements of last century were healthier than the elaborate obstructions of the present system. At that time they had the good judgment to cause all pipes carrying foul matters to pass to the outside of the building at the nearest possible point and to have as short a length of pipe and as few bends as the arrangements of pipes would allow. The sewage and refuse were hurried from the premises by slowly turned bends and direct routes, bnt the engineers and medical officers of the present day demand numerous obstructions, and often call for the most roundabout method of laying down private drains, so that they require inspection or lamp holes, together with special ventilation shafts to prevent the drains becoming blocked and the sewer gas that they generate from poisoning the inhabitants.

E. M. Close, chairman of the health department of the Birmingham Sanitary Institute, England, when giving his annual address at the 17th Congress in September last, stated that placing interception traps and breather pipes on private drains was wrong, and that all private drains and public sewers should have free and uninterrupted ventilation throughout, and in another remark declared that the architects of the present day appeared to have entirely lost sight of the question or art of drainage. At the same meeting W. Hannan stated that house drainage could easily be kept free from sewer gases; it was only necessary to arrange the waste pipes so that sewage would secure plenty of aeration, which would cause it to remain fresh during the time the fluid was rolling from the house to the outfall end of the main sewer. He also stated that all traps were putrefying machines and incubators, where dangerous germs are bred that pass out into the sewers and rapidly multiply. The whole discussion of this select company of sanitarians at the Congress showed that to improve sanitary apparatus, the use of traps and similar impediments should if possible be avoided. Some expressed the opinion that the time was not far distant when the use of traps to keep back sewer gases would be totally discontinued and become unnecessary.

This seems to me exceedingly probable, for I see no reason why a new town cannot so arrange its refuse and sewage business that it can be removed in a way that sewer gas and foul, unhealthy odors cannot possibly generate in any part of the pipes, and also having the advantage of costing considerably less than the intricate obstructive system at present forced on the people. To do this there must be separate drains and sewers, one set to carry the sewage and the water from the roof and yard of dwellings, and another set to carry the storm water from the streets and land, together with any clean water springs that are within the watershed. To do this the sewers must not be too large. Every branch taken from the street sewers must be taken from the crown, and continue with an upward grade, void of any interruption or interception



traps, to the highest point of the building it serves, or the nearest building or large tree. Every separate line of sewer serving a street must have a shaft at its lowest point for the inlet of fresh air, and another of the highest terminating point to form an outlet of air in a way that even the smallest pocket is avoided where it might be possible for air to lodge, and to ensure a free and rapid circulation of air from the lowest point of each and all the street sewers to above the housetops. Then the plumbers must fix the waste-pipes in the interior of the buildings on the same plan, viz., every separate line of waste-pipes must be continued to above the roof, independently, and in no case must any two or more lines be joined together. It is important that care should be taken to ensure the above related points being carried out in the smallest details, because those who have followed my remarks in previous articles will know that sewage contains the germs that will if properly set to work purify and make clean again the polluted fluid, and all that is necessary for the engineer and mechanic to do is to so arrange the carrying pipes that the sewage during its transit is broken up into particles, and that an unlimited supply of fresh atmospheric air is provided at all points and places, ready to be absorbed by the fluid when needed.

If this be done no sewer gas will ever be generated, because the sewage will remain fresh if kept in rapid motion until it reaches the terminating end at the outfall. If no sewer gas is generated then there need be no appliances used to prevent sewer gas doing injury to the public health. The experiments made by Herr Unna, at Cologne, proved that when sewage was falling down a vertical line of pipe it split and divided into thin threads that enlarged the stream to the full size of the soil or other pipe used for the discharge, and that during its fall down the vertical pipe it got mixed and carried with it at least four times its own volume of atmospheric air, drawn

in through the open end above the roof. All plumbers should bear this in mind, for it proves that their work is very important, not only in preventing sewage from generating poisonous gases, but that they can by properly arranging their lines of waste-pipes cause the sewage to commence purifying itself at the very moment that the clean fluid has got fouled. In previous issues I have supplied illustrations and descriptions how to do this, and tried to prove that the system of connecting two or more lines of pipes together is decidedly wrong and injures rather than assists ventilation by retarding the proper circulation of air through the whole length of waste-pipes, which must be the object aimed at to ensure a high standard of health.

It is the practice in cold countries where the atmosphere is impregnated with sea salt, or where the temperature during any part of the year does not fall too much below the freezing point, to continue the old eighteenth century method of running all soil and waste-pipes outside the walls of the buildings, and passing all waste-pipes from interior water-closets and other sanitary appliances through the house walls at the nearest convenient points, and they all work well, but the practice would not work smoothly in the northern parts of this continent. I have a system of this kind working here in Toronto on the outside soil-pipe plan, and so long as I attend to the arrangements myself it answers all right, but if a tap be leaking and allowing the water to dribble down the waste-pipes when the temperature is below zero, it freezes at the point where the short piece of horizontal pipe that passes through the wall joins the vertical pipe fastened to the face of the outside wall, but when this small leakage is avoided, it answers well even here at the lowest temperatures, but the latest American system of erecting stacks of soil-pipes of good metal and joints, on the open principle, vertically through the interior of the buildings, can be made quite as safe and sanitary, and have the advantage of not being subject to frost. I have before suggested a way of arranging waste-pipes that would ensure the freedom from sewer gases in dwelling houses when a connection has been made to the present sewers or sewers that manufacture sewer gas because they have not been laid so as to be self-cleansing, aerated properly (see article on sanitary appliances published in The Canadian Engineer in April, 1897), and I here propose to show a way of connecting the branches from sanitary fixtures to vertical soil-pipes or any other line of waste-pipes serving other fixtures that are too far removed from the soil-pipes to be properly connected with it, in the way shown by these illustrations. I might add that no two lines of waste-pipe which terminate with an open end above the house roof should be joined together on the vertical line, except on the street side of the quarter bend at the foot, and in no case where there is another waste-pipe that branches into the vertical stack at a lower point. When this error is made the suction of air that passes down the lines of pipe when slop water is sent down, is impeded, and the current of air that comes up from the street sewers to the housetop is curtailed by friction, having to split at the dividing junction.

It should be the aim of all plumbers to avoid as much as possible low-grated horizontal pipes and pipes too large for the fixture or for the waste plugs in the fixtures they serve. They should avoid all sharp angles and junctions on main lines of waste-pipes, and any roughness or solder drops on the inside of the waste-pipes. They should also aim at having the insides of all waste-pipes smooth and free from the least impediment throughout the whole length of the pipes, and neither increase or decrease the bore of any vertical line of waste-pipes from the junction at the ground line to the terminating point above the roof. Herr Unna shows why care on this point should be observed in the Cologne experiments. They should also do away with the dirty, unsanitary practice of placing waste-pipes, bath traps and water-closet bends between the floor boards and the ceiling, because they are apt to freeze and defects cannot easily be seen or repaired. The sweating of the pipes when the temperature of the air is higher than the water passing through them causes the ceiling to soften and smell, and there are also more angles and sharp turns in the pipes than there need be or is good to have in waste-pipes for the health of the inhabitants. For the sake of securing a fine outside appearance nothing should be done to jeopardize the smoothness or increase the friction, or retard the flow of air or fluid within the pipes. All branches made in hard metal pipes should be made to bend slowly both above and below the branch inlet to allow for the easy escape of the air as well as the sewage (see Fig. 1 to 5), and at the same time leave the vertical pipe free to pass down the atmosphere air drawn in by the falling sewage, and also to do away with the shoulder space that is at present usually created if an ordinary T. Y. is used, which always forms an air pocket and breeding space for microbes. In joining lead pipes together this could not be done, nor is it necessary, because in the usual course of fitting a short length of horizontal pipe of about 1 inch bore and 2 feet long would be used to carry the waste water from a wash-basin to a 2-inch or 1½-inch vertical stack of lead pipe; the fluid would rush through the short length of pipe fixed between the basin and vertical line of larger lead pipe at full bore, and dash to the opposite side of the larger stack of vertical pipe, whose top end was open and extended to above the roof, then the fluid would split up and suck down the air from the roof and take a large quantity with it down to the common sewer. And if the basins, the baths, the sinks and wash tubs can all be placed close to the vertical line of the soil-pipe they should be joined to it on the same principle as shown (see Fig. 3) because the more a pipe is used the better for health.

The illustrations show four different kinds of water-closets. The syphon is a closet, a pattern that I cannot approve because it contains a double trap, one which cannot easily be emptied or inspected. Then it delivers the water down the soil-pipe with a rush in bulk and unbroken, therefore the fluid does not get mixed with air in the vertical soil-pipe as it should do, but draws the air behind it in a bulk form which never mixes with the sewage, and when the air reaches the point where the sewer is larger in bore than the interior of the soil-pipe, and the vacuum becomes broken, then the air returns to the outside atmosphere the easiest way possible without performing any aeration of sewage. Fig. 2 is a similar closet without the syphonic part, which I approve because the trap part is independent of the bowl and can be set to point to the right or left hand, so that the soil-pipe can be erected on either side of the closet bowl, and the bowl can be set with the flushing horn to the rear, which is the proper position to receive the flush-pipe from the cistern. The trap can be made of brass, nickel plated if desired, or cast in lead, and joined together by a mixture called earthenware solder, which easily makes a joint as safe and strong as the body of the basin, so that having a joint under water is now of no detriment. Fig. 3 is a common basin that has not sufficient area of watered surface to receive the droppings or keep the interior of the bowl clean. Fig. 5 is the simplest and most satisfactory sanitary closet of the four, but to connect this kind of closet to the soil-pipe in the way that it

is manufactured and shown, the soil-pipe must be placed at the rear of the closet and the flush-pipe at the same place. This arrangement would in nearly all cases be very inconvenient, and make it hard to join other connections to the vertical soil-pipes. By Fig. 4 I show how any wash basin, bath, sink or set of wash-tubs should be connected, taking care to fix the short branches level, so that no pocket of air can accumulate between the fixture trap and the vertical soil-pipe. If by reason of the great distance between the fitting and the vertical waste-pipe, a perfectly level pipe is too long and would not work well, then another line of vertical pipe must be made that can be set nearer the fitting to accept the short branch. No line need be erected perfectly plumb from the foot to head, but may be bent to suit circumstances, on condition that a good upward grade is always obtained in every part, and all branches are inserted in the vertical portion and not into the graded portion. The reason for this will be obvious to mechanics.

A few years ago the improvement in drainage and plumbing took a wrong turn and large sums of money were being wasted by municipalities, causing the people at the present time to be slow to spend more money to undo the evils thus created. But there are other towns which would not reorganize their sanitary laws to comply with the new ideas because of the large expense it entailed, and the nuisance of the long delays and inspection, etc., required. Then some experienced sanitarians could not see the advantages stated by the promoters of the new system, only the one that would increase the cost and circulate money. These towns are fortunate, for the experiments lately made have not only proved the extreme folly of the obstructive system (which can easily be proved by watching the gases coming out of the street grates on a hard frosty day), but have found out how easy it is to arrange both sewers and plumbing so that no sewer gas can be manufactured in them, therefore the public could not be poisoned with it, and our private drains and main sewers may by using reasonable intelligence during construction be made as odorless as any other part of our inhabitable premises.

THE ETHICS OF CIVIL ENGINEERING.*

I do not intend to inflict upon you a long historical sketch of the engineering works which have been commenced or completed during the past year, for the daily papers with their well written articles and photographic accompaniments bring these matters attractively to our notice, and the technical journals record them with such close detail and elaborate drawings that they are in everyone's mind or on our book shelves as works of reference, far more valuable and with infinitely greater facility for reference than any words of mine would possess. A few words to the students and young members of our society may, however, be of some service, and, if devoid of any other merit, will, I promise you, possess the merit of brevity. With such institutions as McGill College, which the young man of to-day, especially those within easy reach of Montreal, possesses, he will be well equipped for, and should move forward erect and with a firm and steady step, indicative of his honesty and firmness of purpose. In due course he will no doubt secure an engagement on some public work (thanks to his McGill diploma), and his success will be in his own hands. He will probably be located in some small town or village, a stranger to everyone, and, if he has not already done so, he should formulate for his guidance rules of conduct based on common sense, which will win for him the confidence and respect of the community, which are as necessary for his advancement as technical knowledge. He should be cheerful and affable. He should move slowly in forming acquaintances, that he may not make mistakes which it would embarrass him to correct. He should not pose as a puritan, but should avoid saloons and gambling as he would the plague. He should be early in the field and late in the office when the necessities of work require. He should make it a point to have his work well laid out in advance and detailed plans prepared early, that the contractor may have no grounds to complain of delay on his part, for it is of the first importance that the contractor should have facilities for changing his men from place to place or putting on a large force when conditions are favorable. It may also affect the contractor's profits if plans of structures are not furnished at an early day, that he may arrange for materials when prices and conditions are in his favor. In preparing detailed plans, utility and durability should be studied. Standard sizes and shapes should be used as far as conditions will permit, as a departure from standards means not only increased cost, but difficulty and often serious delay in obtaining materials. He should cultivate the habit of observing closely what is being done upon the work, how and with what appliances it is being done, and who is doing it. He should make himself familiar with the roads and short cuts in the neighborhood of the work, and their varying conditions as affected by the weather and seasons. In short, he should be perfectly at home in everything connected with the work and its surroundings, that he may be eligible for advancement when opportunity offers. When measuring the work for the monthly estimates, he should, as far as time will permit of his doing so, return the actual quantities of work done and materials delivered, as it would be unfair to the contractor to underestimate the work, and an unkindness to him to over-estimate it, as to do so would be misleading and disappointing when actual quantities were returned, as they would eventually have to be. By assisting the contractor in the various ways above mentioned, it will be less difficult for the young engineer to say no when his duty requires him to do so, and that unpleasant duty will, no doubt, have to be occasionally performed, particularly about estimate time, when large estimates are often asked for by the contractor "to tide over pressing needs, and to be adjusted in the next month's estimate." Such a course should never be followed. The actual quantities should be returned to the senior engineer with the statement of facts. Young engineers beginning practice to day have advantages which their seniors educated in this country have never had, and no more genuine and sincere assurance of the appreciation of the munificent donations which have made McGill College what it is can be given the donors than to see the lecture and experimental rooms and museums thronged with bright and earnest students making every possible effort to possess themselves of the wealth of knowledge so generously placed within their reach, and so easily acquired with the assistance of McGill's able professors. A thorough grounding in the fundamental principles of any profession or calling is as necessary for the individual independence and stability which every man should strive to possess, as a solid foundation is for the stability ot a structure. This thorough grounding McGill College affords, with facilities which cannot be surpassed, and I would urge upon our students and young members to avail themselves of these advantages to the fullest extent possible. Theory and a large portion of practice, especially in the results obtainable from the testing machines, here go hand in hand, and the earnest and painstaking

*Being the opening address of President W. G. McN. Thompson at the annual Convention of the Canadian Society of Civil Engineers.

young engineer, almost at the commencement of his career, may be in possession of information which others have picked up like crumbs here and there in course of a lifetime, as failures of works or "accidents" have offered opportunities to careful students, for we are all students in engineering until the curtain falls in the last act of this existence. The college course, however, will soon come to an end, and the young engineer must start out to make his way in the world. If he is well grounded, as we will assume, has a McGill diploma in his pocket, his trust in Providence and his powder dry, at such a time the prudence of not accepting presents or having any money dealings with the contractor will be fully realized. He should carefully check the work in the field and in the office, remembering that, in addition to his duty to himself, he owes it to McGill College to maintain the standard which his diploma should give assurance of. He should be reticent about the work, excepting with his senior officer, to whom he should give a full measure of loyalty and carry out his instructions promptly and cheerfully. He should be free from prejudice and strictly fair. If he will observe these rules, and it needs but a little firmness and self-denial to do so, he will forge steadily ahead, as men of such character are always in demand.

—After a squabble lasting for years the contract for the elevators in Toronto's new city hall has been let to Leitch & Turnbull of Hamilton, at a figure much below the tender of the Fensom Co. of Toronto. After the contract was let the architect, as is his habit, found a few alterations necessary and it is said the figures for the plant will after all be about the same as the Fensom Co.'s price.

—At the last annual meeting of the American Public Health Association, at Ottawa, J. W. Hughes, Montreal, read a paper entitled, The Intercepting Trap in Private Sewers, in which he quoted very fully from the series of articles in THE CANADIAN ENGINEER on that subject from the pen of W. M. Watson. In the published reports of the paper in this country, Mr. Hughes kindly credited the author and publication, but in the report published in the Surveyor and Municipal and County Engineer, London, Dec. 30th, 1898, we find, no doubt through inadvertence, no mention of an author other than Mr. Hughes, though the paragraphs quoted by the Surveyor are from the columns of THE CANADIAN ENGINEER.

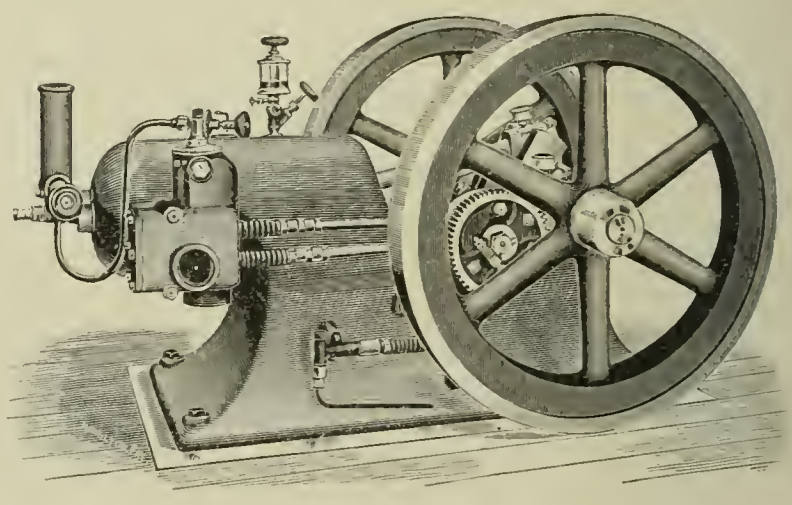
—The great solidity of the masonry of old Montreal buildings and of the fortification walls and other masonry throughout the province of Quebec generally, has been the admiration of engineers and the dismay of contractors who have occasionally had to dismantle these structures. A correspondent informs us that the secret of this great strength is that the French Canadian builders of old made a practice of seasoning their mortar by burying it in the earth over winter. The mortar was prepared in the autumn; a pit was dug below the frost line, the bottom being lined with sand and a wall of sand being put in the sides as the mortar was dumped in. The top was then also covered with sand and the bed covered deep enough with earth to keep away the frost.

THE QUEBEC BRIDGE.

The company proposing to construct the bridge at Quebec will open the tenders after March 1st. The story recently published in the daily press, and even repeated by some of the technical journals, to the effect that the Government was asking leading firms to tender, is of course untrue, and the Government has nothing to do with the matter. The bridge is in the hands of a company which hopes to receive aid, as has been promised, from the Dominion, Provincial, and municipal governments, but the company alone is in conduct of the business of the erection and maintenance of the structure. At present the cost of the structure is estimated at from 2½ to 3½ million of dollars for the bridge itself, the shore approaches probably costing another million.

THE MODEL GAS ENGINE.

A constant demand from users of small power for an efficient engine that could be handled with little expense and without the aid of an engineer, has brought into existence the gas and gasoline engine, and the makers of the Model Gas Engine unhesitatingly state their confidence in its ability to perform satisfactorily every requirement of the work it is calculated to do. The advantages of the Model Gas and Gasoline Engine are claimed to be many. We mention a few:—It can be run at trifling expense; no expense when not running; little floor space; no explosions; no danger; no smoke, dirt or noise; ready in five minutes; can be operated by a boy; can be run with either gas or gasoline. To start the Model Gas and Gasoline Engine, turn balance wheel a half turn forward, then a half turn backwards, and the engine



starts. This is within the power of a fifteen year old boy, even if the engine is 12 horse-power. The Model is wonderfully simple. So few are its working parts that it seems almost incredible it should do its work so perfectly. There is not a lever, rod or working part of any description inside the bed plate, not even a cylinder head or water joint. There are no joints opening from the water jacket into the bore of the cylinder.

The "Model" takes the gasoline direct from a tank supplied by a pump. The gasoline tank is situated outside the building at any distance desired, and the gasoline is pumped to a small tank at the engine. This small tank is kept constantly full and has an overflow back to the large tank. We use the hot tube igniter in preference to the electric spark, as the latter is so hard to keep in order However, the makers will furnish same if desired. The governor of the Model Gas and Gasoline Engine is of the type that regulates the supply of gasoline according to the amount of work being done, by shutting off the supply when the speed increases above the normal. The advantages of this over a graduated charge governor lie in the fact, the makers state, that if a small charge be admitted it will not explode and be thus wasted. The governor in use on the "Model," it is said, overcomes all these objections, and keeps the speed as regular as possible in a gas engine. The Model Gas and Gasoline Engine is made by The Goldie & McCulloch Co., Limited, Galt, Ont, who make any size, and give particulars of large sizes on application.

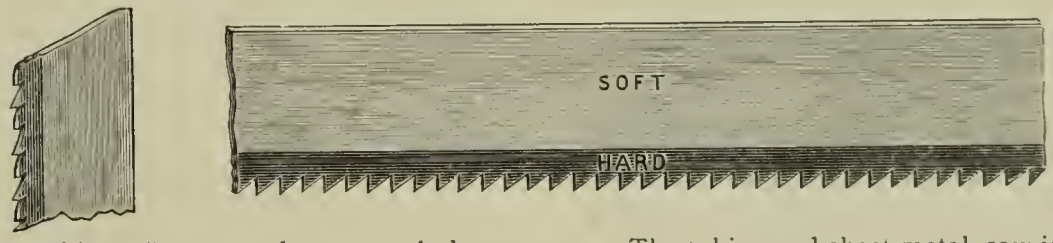
SAWS FOR CUTTING METALS.

Comparatively speaking, it is not many years ago when the only saw known on the market for cutting metals was one in which the blade was made of steel drawn down to a spring temper, and hardened equally throughout, consequently the hardness of the teeth and back were the same. The result was:—1st: That the teeth having only the hardness of spring temper, could not cut any metal harder than itself; 2nd When dulled by use, required to be re-sharpened by a file; 3rd: The blades were expensive, which precluded their universal use, in addition to their limited capacity. It was the custom in machine shops, when a piece of steel was to be cut, and especially hard tool steel, either to cut it in a lathe or planer, or send it out to the blacksmith to heat and cut: both these methods were expensive, but the latter had the additional disadvantage of deteriorating by heating in the forge, and its being returned in such a rough shape as to require additional machining. The advent of saws made on the flexible back principle, has changed the old system, and now it is a very rare occurrence when a blade equally tempered throughout is either found in a machine shop or, in fact, on

the shelves of hardware dealers. The reason for this is, that by the flexible back principle (see cut) the teeth only are hard, the back remaining soft.

The advantages are: 1st. The hardness of the teeth being such that a file will not touch them, thereby enabling the Eureka flexible back hack saws to cut any metal a file will touch. It is an every-day occurrence its makers claim that the Eureka flexible back saws are cutting not only unannealed tool steel, but every metal and substance imaginable: 2nd. The back being soft prevents the saw from snapping or breaking in two; consequently the life of the saw is insured until it is absolutely worn out by use: 3rd. By improved methods of machinery, the Eureka flexible back hack saws are not only manufactured with an accuracy hitherto unattainable, but are put on the market at such an exceedingly low figure that when worn out they are thrown away, the labor and cost of files in re-sharpening being greater than the cost of a new saw.

In the old days any piece of steel with teeth on one edge was called a saw, and was used for every purpose up to its capacity, which, however, was very limited; but in these days of specialties, experience has taught that a saw blade should be made adaptable to the work, and not the work to the blade. By studying the requirements of different classes of workers in metals, the Eureka flexible back hack saws are made with especial objects in view, and therefore differ not only in the number of teeth to the inch, but also in temper or degrees of hardness. Another method of cutting metals, which has revolutionized old systems, is the use of the automatic power metal sawing machines. These machines use saws attached to an arm, having a reciprocating motion, and as they work automatically, when the work is put in the machine no further attention is required, and when the metal is cut through, the machine stops; a boy can run, and does in some factories, the makers assure us, a dozen machines. In many other cases a lathe or planer hand has sufficient time to run one or more automatic machines without detriment to his special work; hence the work of cutting the metal costs practically nothing in labor, besides effecting a saving in material over the old methods. The X L power saws have met with a widespread success in use in these machines, for the reason that they are not only made on the flexible back principle,—hence, no breakage, and assuring the life of the blade until worn out,—but are constructed of steel of heavy gauge, thereby preventing any bending or bowing of the blade and causing the blade to run straight. Although the automatic power sawing machines fill a long felt want, still their scope is limited to straight cutting. There remains a demand for a proper cutting instrument to cut irregular sizes, curves, metal sprews and castings, or any metal outside of straight cutting, in fact the scope of automatic power sawing machines is limited even in straight cutting; hence the success of the band metal sawing machine, for the reasons: 1st. It cuts continuously, there being no loss, as in reciprocating machines. 2nd. Its speed is very much greater, as the saw is driven in conformity with the hardness of the metal to be cut, hence the reason why a four-cone pulley is recommended for each band saw frame, thereby enabling the operator to cut the softest brass or the hardest unnannealed tool steel on one machine.

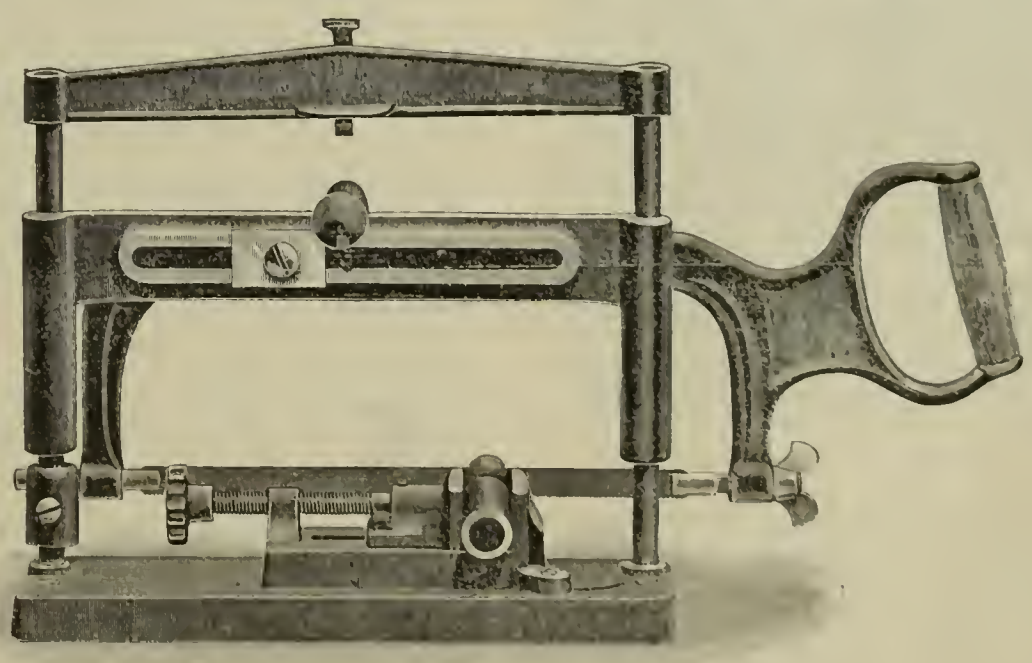


Heretofore band saws for cutting metals have been imported from France and Belgium, but these importations have practically ceased, it is said, for these reasons: 1st. They are made from spring-tempered steel, consequently cannot cut any substance harder than itself, i. e., cannot cut tool steel. 2nd. As they are made from steel, spring-tempered, so called, they are hardened throughout, thereby causing rapid crystallization, hence breakage; again, when dull, require filing, but on account of the crystallization above stated, the saw will admit of but few filings. These defects are overcome by the use of the Thompson flexible back band saws (see cut). The teeth are hard, harder than the metal to be cut, but the back is soft, thereby preventing crystallization. The saws are so inexpensive that they are never re-filed, in fact it would not pay to expend the time of labor and the cost of files in so doing.

The Thompson flexible back band saws, manufactured by the Henry G. Thompson & Son Co., New Haven, Conn., U.S.A., are not an experiment, but have been in use for a dozen years in cutting almost every conceivable substance, from onyx and pearl, down to the softest metals:—as iron, steel, brass, copper, bronze, sheet metal, tubing, sprews, pearl, onyx, etc., in fact any substance that a file will cut by manufacturers of machinery, jewelry, dies, irregular shapes, scrolls, chandeliers, cornices, steel, roofing, stamped ware, cutlery, silverware, tubing, specialties, mica, slate, etc.

The tubing and sheet metal saw is made from steel 23 gauge, 30 teeth to the inch. It is designed expressly for cutting thin iron, steel, brass, and copper tubing, and sheet metals. The makers state it is just what is wanted by bicycle makers and repairers.

Those interested in this subject can obtain full information from Aikenhead Hardware Co., Toronto.



GOODELL BENCH HACK SAW.

The Goodell bench hack saw, made by the Goodell Brothers Co., will saw squares, angles, tubing or rods. It is well made. The Aikenhead Hardware Co., Toronto, will give prices, etc.

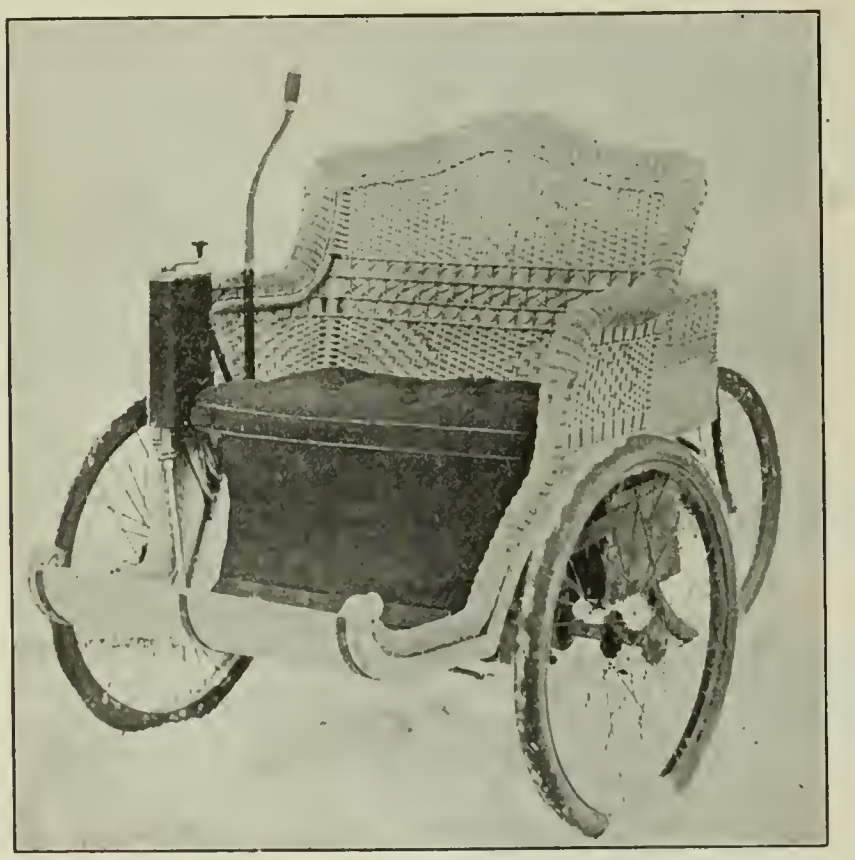
METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports of interest to the metal trades during December, 1897 and 1898, and the twelve months ending December, 1897 and 1898:—

	Month of December.		Year.	
	1897.	1898.	1897.	1898.
Hardware	£4,327	£1,549	£68,172	£25,717
Cutlery	..	9,677	..	116,850
Pig iron	225	42	9,447	11,322
Bar, etc.	263	1,653	8,892	13,315
Railroad	..	3,518	45,796	28,766
Hoops, sheets, etc.	112	1,664	77,954	64,893
Galvanized sheets	5,185	761	57,573	65,968
Tin plates	7,149	13,386	224,570	172,362
Cast, wrought, etc., iron	4,625	2,802	34,066	34,696
Old (for re-manufacture)	170	..	7,524	3,574
Steel	3,946	2,372	55,764	49,483
Lead	978	1,067	28,379	36,943
Tin, unwrought	3,356	1,003	21,021	18,272
Alkali	1,361	1,736	44,550	50,608
Cement	2,701	636	22,536	26,018

THE AUTOCAR INDUSTRY.

The chief feature of progress during the past month has been a Canadian production of novel construction and appearance which is illustrated on this page. A representative of THE CANADIAN ENGINEER has had the pleasure of riding in this electric motet with the inventor of the battery and motet, W. J. Still, mechanical engineer of the Canadian Motor Syndicate, on whose design the carriage was constructed. The motor is slung over the front axle, and the two front wheels drive, while the hind wheel steers by means of the handle held in the left hand of the driver. In going over rough block pavements the effect of having the single wheel drawn over the roads from behind instead of pushed in front is very noticeable. In the ordinary tricycle construction, where the single wheel precedes, every depression and obstruction in the road produces a shock which is immediately felt, to the great discomfort of the occupant. In this electric motet it was noticeable that the block pavements, which on some of the streets traversed were very rough and full of deep ruts, did not materially affect the comfort of riding, the shock of contact being minimized by the two front wheels, and the dropping of the hind wheel into the depressions having no perceptible effect on the occupants. It starts



CANADIAN ELECTRIC MOTET.

Total weight, 400 lbs.; battery weight, 180 lbs. (Still Patent Battery); capacity, 2 persons and 50 lbs. of baggage, or, fitted for light delivery, 250 lbs. and driver; speed, 12 to 15 miles per hour; range (without recharging), 30 miles; steers by hind wheel, guided by left hand; steering handle lifted, as shown in photo, when occupant leaves seat; controller (in right hand) has four positions, reverse and brake; current used, 15 amperes on ordinary roads; power from special motor, designed by W. J. Still, giving 3½ h.p. for 70 lbs. weight; extreme length of wheel base, 4 feet; extreme width of wheel base, 4 feet; cost of running, ½c. per mile; turns in smaller space than a bicycle; price, f.o.b. Toronto, $400.

and stops without any of the jerking which we have noticed in other autocars we have examined. The motet presents an unusual appearance which is pleasing to the eye, while the rattan body mounted on spiral springs, adds elegance as well as comfort to the vehicle. The absence of the conventional dashboard gives the rider a peculiar sensation at first, but as he is prepared for novelty this feature becomes only one of many contributing to the pleasurable sensation of a rapid run. The facility of movement is one of the strong features of this little vehicle, which turns in less space than a bicycle requires. It is equipped with the Still patent storage battery weighing 180 lbs., and has a range of 30 miles. By increasing this weight to 300 lbs. the range could be increased to 40 miles without recharging—a greater range than has yet been obtained by any electric carriage. It may be added that the cells with which this motet was equipped at the time of our ride were the old ones that had been used in the electric victoria formerly described in these columns, and which on account of an accident to that carriage had been idle for about eight weeks. Mr. Still stated that with an equipment of new cells made upon his latest type of construction he could secure a range of 40 miles with a battery weight of about 200 lbs. The cells can be charged from any circuit. The motor, also invented by Mr. Still, is of special design, giving great power, but details were not available for publication at this stage. At the reasonable price asked for the motet there should be a large and immediate sale for them. The construction of this beautiful and serviceable carriage opens a large field for various types of bodies, ranging from a light delivery vehicle consisting of a simple box with seat in front, to a miniature hansom with the driver seated in the rear of the box, the front being enclosed in glass, so that the view of the occupants would be entirely unobstructed. Such a carriage would be able to accomplish all that is now obtained by the large and cumbrous hansom cabs in London and New York, the total weight of which is 3,200 lbs.—eight times that of the Canadian electric motet. In spite of the smallness of this vehicle—or perhaps because of it—the motet carried Mr. Still and a passenger weighing 240 lbs.—a total load of nearly 500 lbs.—up hill on Avenue road, Toronto, a grade of 10 per cent Two motor carriages of other makers—one electric and one gasolene—failed to accomplish this feat. For city use, and even for protessional men who have country practice, electric carriages are found to fully answer all demands, the investigations made by Col. Pope—who placed cyclometers on ordinary run-about conveyances of a number of private citizens, surgeons, expressmen, etc.—having shown an average mileage of 18 miles per day, and with one exception a maximum mileage not exceeding 25. Of course with a duplicate battery 100 miles per day could be made.

Since our last issue further details are to hand in reference to the exploitation of compressed air in New York, to which we referred in last issue. The following are the names of the companies already organized: American Air Power Company, capital $7,000,000, controlling works in New York city and compressed air street cars for United States; International Air Power Company, capital $7,000,000, with works at Worcester, Mass., and Providence, R.I., to sell compressed air auto-trucks, engines, locomotives and automobiles; New York Auto-Truck Company, capital $1,000,000, general truckmen, using International Air Power trucks, and owning charging stations throughout New York; Chicago Auto-Truck Company, capital $10,000,000, controlled by the Leiter-Hoadley Syndicate, the same business as New York Auto-Truck Company; Philadelphia Motor Wagon Co., capital $1,500,000, for manufacture of self propelled wagons and for vehicles, supposed to be connected with the Cramp-Hoadley Syndicate of New York; Philadelphia Auto-Truck Company, reported capital, $10,000,000. A certain air of mystery surrounds these companies, and although the newspapers are careful to state that "no stock is for sale," we predict that when the promoters think the time is ripe the stock will be put upon the market at a big premium. As proof of this we point to the fact that the stock of the New York Auto-Truck Company, which was listed at 9 in September, 1898, was sold at 48½ on January 14th, 1899, the day on which the present organization was completed; jumped to 62 on January 16th, to 68 on January 17th and on January 18th was quoted at 71. Mr. Knight, one of the inventors, in an interview stated that owing to pressure from large financial men he had been induced to increase the capital stock of the International Air Power Co. from $1,000,000 to $7,000,000. This explains why the stock jumped. Of the $7,000,000 capital above referred to, $6,400,000 represents property and $600,000 is to be put on the market as preferential stock with 3 per cent. cumulative dividend. The surplus over this $600,000 will represent profits made by the promoters.

With regard to compressed air vehicles, there is one point of considerable interest to all engineers who are watching this problem. We observe the power is stored in steel bottles charged with 4,000 lbs. to the square inch. This is considerably more than has ever been attempted before, and we notice that the tubes are only 5-16 inches thick. Of course there is no doubt that nickel-steel has a very high tensile strain, and it is just possible the bottles made of this substance may stand the test, as stated in the reports, of 1,8000 lbs. to the square inch, but there is a point worthy of very careful consideration as to whether these bottles will withstand the constant vibration they will experience on the road without very rapid crystallization of the steel. This would be especially likely to take place, suspended as these are upon the reach of the vehicle. This we think should be thoroughly tested before any such vehicles are put on our public streets, as the danger of

explosion of such a bottle as this loaded to 4,000 lbs. to the square inch would be a severe menace to life and property. The destructive results of the rupture of one of these tubes would be much increased by the fact that with their fibers crystallized by constant jarring they would inevitably shatter to fragments, and the pieces would be scattered in all directions.

Considering the fact that the Hoadley-Knight compressed air car made but 15 miles upon steel rails with air reservoirs weighing 3,000 lbs., a very large amount of improvement will have to be produced before it is possible to drive compressed air vehicles over our ordinary thoroughfares for anything like reasonable distances, and we are extremely doubtful whether with the charging stations at one mile apart, as suggested by Hugh Dolner, the use of the storage battery would not be a preferred system.

Compressed Air, the monthly journal published in New York, contained in its issue of August, 1897, some correspondence which is of special interest just now. A correspondent having asked for information as to running a horseless carriage by compressed air, the editor replied as follows: "Compressed air as a motive power has many economical and useful applications, but it has its limitations. Our hope in this direction seems to be confined to the possibilities that might result from the use of liquid air. At present there does not seem to be much encouragement in the use of compressed air for motor carriages. The limited space obtainable and the weight of the apparatus seems prohibitive. A steel tube of one cubic foot capacity with air at 2,000 lbs. pressure (say 9 inches diameter) will contain 268 cubic feet free air, and power required to compress this quantity per minute will be 268 x .43-115 h.p.; or if done in one hour's time will be 2 h.p., and this calculation is based upon the very best type of 4-stage compressor with perfect intercoolers. A pair of 2½ inches x 5 inches single-acting cylinders operating at 100 lbs. pressure require each 32 cubic feet free air when running at best speed (say 400 revolutions per minute), so that out of a storage reservoir of 2 cubic feet, you will only get a run of about four minutes. The weight of a Mannesman steel tube 9 inches diameter, per cubic feet storage, is 82.2 lbs., and weight of 1 cubic foot air at 2,000 lbs., is 10.2 lbs., making a total weight of 92.4 lbs. for every 2 minutes the carriage will run." This reply must have been discouraging to the correspondent, for it would mean that a run of two hours would involve a weight of 5,544 lbs.! And the correspondent wanted to build a carriage on "bicycle lines." The editor's calculation, however, is evidently based on the assumption that the air is used without expansion. This practically is never done in modern compressed air engines. The result of the calculation, therefore, is scarcely fair to modern compressed air systems.

In opening its fourth yearly volume, The Autocar takes occasion to review the present position of the autocar industry throughout the world. The record of progress is interesting. In Britain a year ago there were less than fifty autocars; to-day English-built vehicles, both cycles and cars, may be numbered by the hundred, and with importations would total 500. The British output has trebled, being six vehicles per week. In France a twelvemonth ago the cars were counted by hundreds; now they are estimated by thousands. Germany is going steadily ahead; the United States is beginning to make up for lost ground; and Canada has entered the list of autocar manufacturers. The cab trials in June last brought electricity for the first time in competition with the gas engine, and, to the surprise of all who attended the trials, electricity carried everything before it as a power for the propulsion of public vehicles in large cities. The electric cab fulfilled all the conditions of the Paris companies, even to the question of working cost. The heavy autocar trials demonstrated that electricity must be taken into very serious account in the future for the driving of heavy vehicles, several of which are now running in Paris. The greatest advance in this class of vehicles has been the raising of steam with liquid fuel, and the Serpollet car has shown the possibility of applying this power under conditions where steam has not hitherto been practicable. A good many heavy vehicles have been sent to North Africa, Senegal and other countries. In France, also, steam road traction has undergone an extension, and several new lines of steam cars have been inaugurated during the year.

Our critical comments last month on the reported "fifteen million dollar deal" in autocars by Count Jotemps of Paris, have been fully justified by the facts which have since come to light The sum and substance of the matter is simply this: Count Jotemps, whose wife is an American, took a tour of the motor carriage factories, with the following result: He secured the agency for the Stanley steam carriage in France and Belgium; ordered three carriages from Holyoke Motor Works, contracting to take 50 vehicles during the coming season; did nothing with the Overman Wheel Co., whose carriage was not ready to show; and he arranged with the Fischer Equipment Co., of Chicago, for 100 carriages per year for ten years. Total business, about a million dollars extending over ten years.

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The seventh annual meeting of Ontario Land Surveyors (fourteenth annual meeting of organized Land Surveyors of the Province) will open on the 28th February at the Parliament buildings, and will occupy three days. One of the chief items of business for the Association will be the discussion of revised by-laws for ratification. The programme is as yet by no means complete, but the following papers are expected:—Exploration Surveys, by James Dickson, Fenelon Falls; Survey Act, by P. S. Gibson, Willowdale; Survey of the Boundary between Nipissing and Algoma Districts, A Niven, Haliburton; Azimuth, S. B. Stewart, Toronto; Railway Location Survey, J. D. Evans, Trenton; Permanent Way, W. E. McMullen, St. John, N.B.; Dominion Lands Surveys, C. F. Aylesworth, jr., Madoc; A Railway to James' Bay, Villiers Sankey, Toronto; A Trip to Yukon and Return, Lewis Bolton, Listowel; Surveying and Surveyors, Jos. Cozens, Sault Ste. Marie; Evidence, by M. J. Butler, Napanee; Lake Wawanosh Drainage Scheme, J. H. Jones, Sarnia; Impressions in the Rocky Mountains, B. J. Saunders, Brockville; Forestry and its Relation to Flood Prevention, Thos. Southworth, Toronto; Drains of Field Tile, W. F. Van Buskirk, Stratford; Highway Culverts and Bridges, A. W. Campbell, Toronto. Papers are also expected from H. J. Bowman, Berlin; G. A. Mountain, Ottawa; C. A. Jones, Petrolea, and others.

STONE WORK CLEANING BY SAND BLAST.

Editor CANADIAN ENGINEER.

SIR,—In your issue for December, 1897, page 238, I notice an enquiry for "washing and whitening stone walls," from W. P. M., of Halifax, N.S., but in your reply thereto you have overlooked a method which has, I believe, been successfully used in both the United States and England. It is the employment of the now well-known "sand blast," the current of sand being projected against the face of the building from a hose supplied with air under pressure from any convenient source. This current of air-driven sand effectually cleans all dirt, etc., from the face of the stone and leaves it clean as if fresh from the tool, while it also has this great advantage that it can be applied without injury to carved work, thus saving the great expense of recutting same. It is curious and instructive to remember that the use of "sand blast" was suggested to Gen. Tilgman, who was the first to make commercial use of it, by his observance of the sharp wearing away of the stone of which the Pyramids and Sphinx in Egypt are composed by the sand driven against them by the winds of the desert. In many parts of the East of England, where there is a sandy tract bordering the sea, the window glass will be seen to be ground by the same agency and appears like frosted glass.

When in England last year I noticed enquiries for cheap doors and sashes and wood pulp—both kinds. Possibly you might be able to give pointers on these matters to your subscribers. Yours,

Toronto, Jan. 28th, 1899. H. E. KYLE.

THE PRACTICAL MAN.

To Soften Cast Iron for Drilling.—Heat to a cherry-red, having it lie level in the fire. Then with tongs, put on a piece of brimstone, a little less in size than the hole is to be. This softens the iron entirely through. Let it lie in the fire until slightly cooled, when it is ready to drill.

To Soften Steel.—Cover it over with tallow, heat it to a cherry-red in a clear coal fire and let it cool of itself.

Tinning Surfaces.—Articles of brass or copper boiled in a solution of stannate of potassa mixed with turnings or scraps of tin, in a few moments become covered with a firmly attached layer of fine tin. A similar effect is produced by boiling the articles with tin turnings or scraps and caustic alkali, or cream of tartar. In either way, articles made of copper or brass may be easily and perfectly tinned.

Varnish on joints is better than the average red lead.

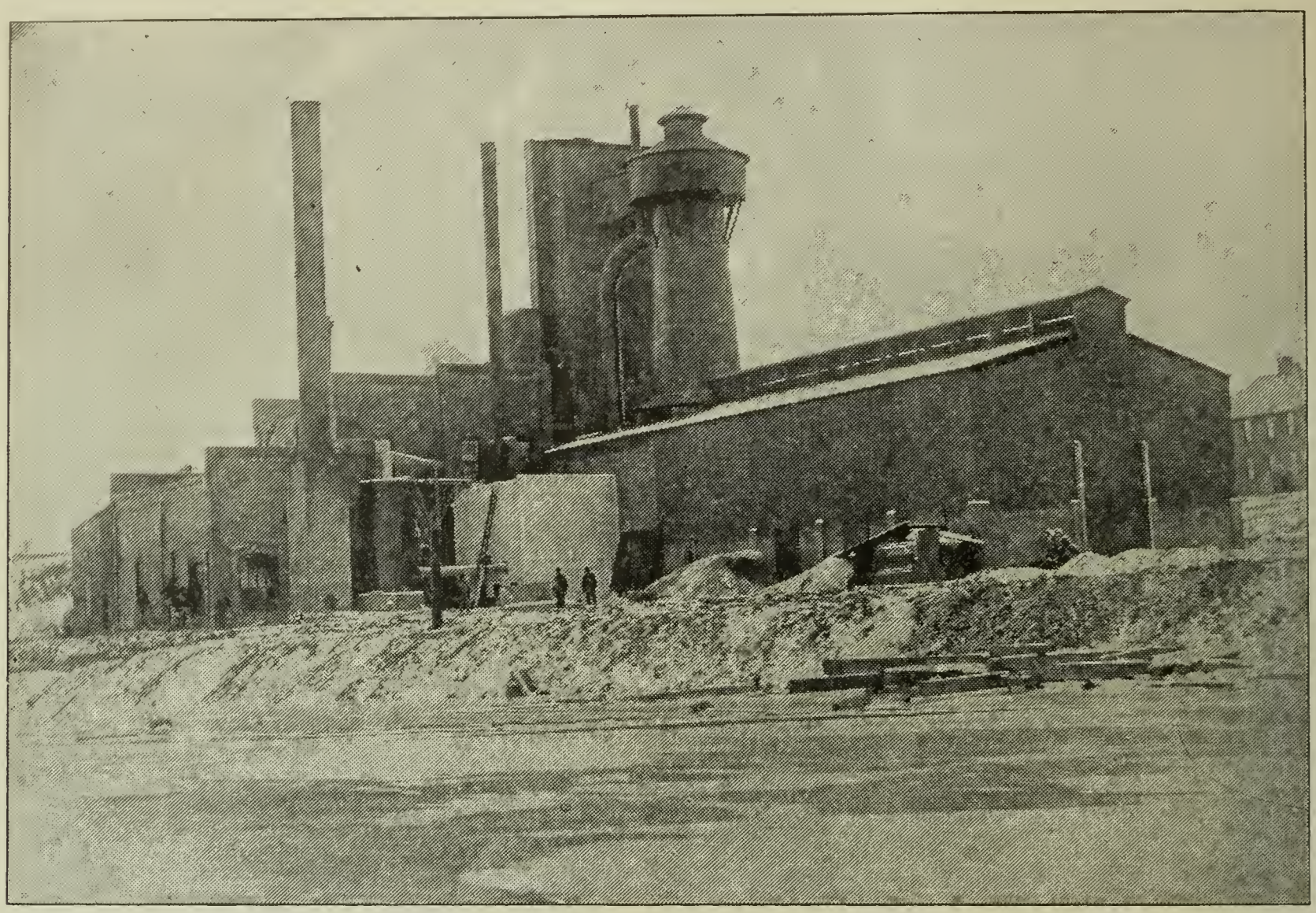
To Restore Burnt Steel and Improve Poor Steel.—Borax, 3 ozs.; sal ammoniac, 8 ozs.; prussiate of potash, 3 ozs.; blue clay, 2 ozs.; rosin, 1½ lbs.; water, 1 gill; alcohol, 1 gill. Put all over a slow fire, let it simmer until it dries to a powder. Heat the steel not above a cherry-red, dip into this powder and afterward hammer.

Rosin on the blacksmith's forge improves and toughens steel. When the tool is hot dip it into the rosin, then hammer.

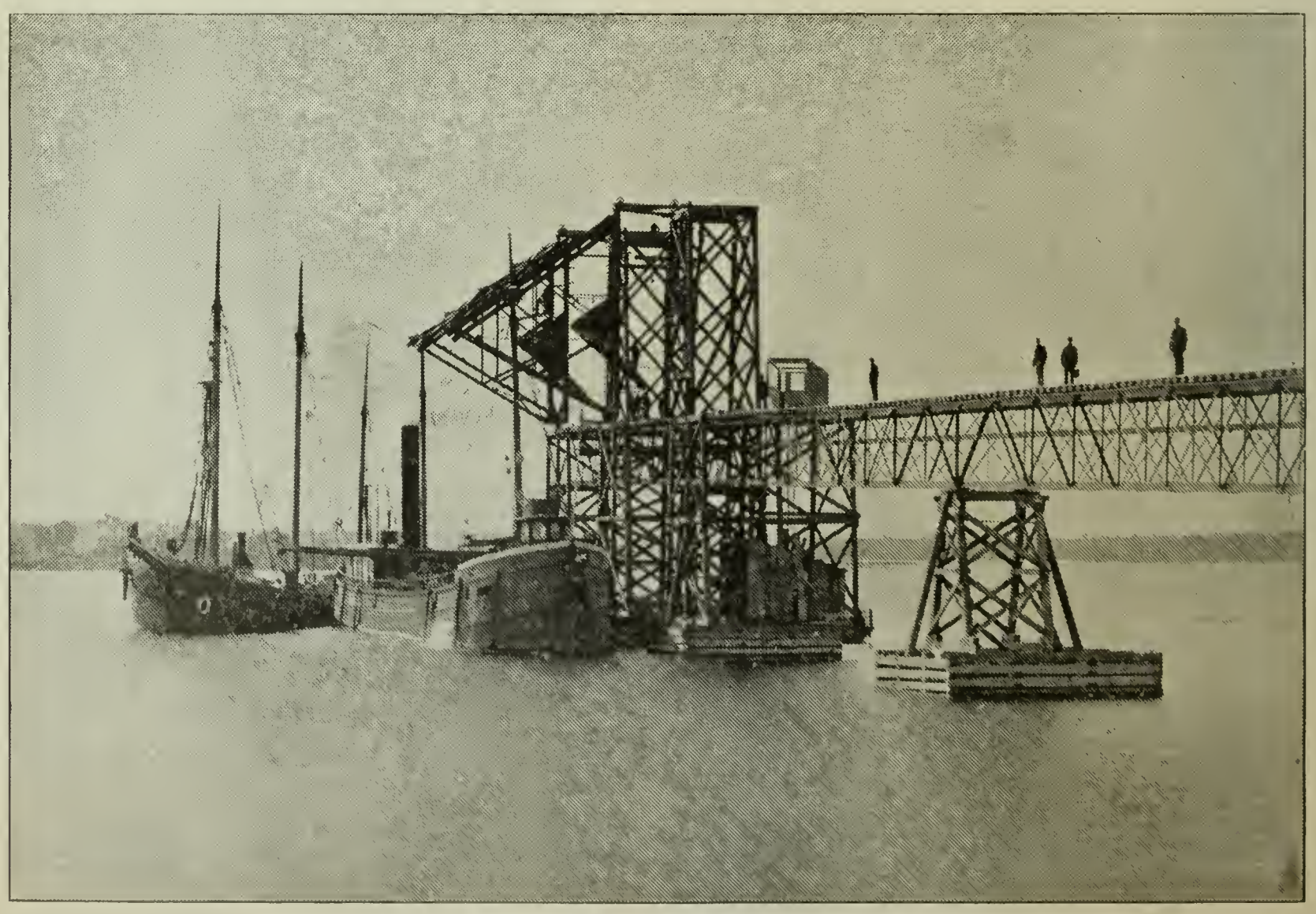
To Copper the Surface of Iron or Steel Wire.—Have the wire perfectly clean, then wash with the following solution, when it will present at once a coppered surface: Rain water, three pounds sulphate of copper, one pound.

THE DESERONTO IRON CO.

The manufacture of charcoal iron was begun by the Deseronto Iron Co., at Deseronto, Ont., on Jan. 25th, 1899, as reported in the Deseronto Tribune. The manufacture of charcoal iron, although for many years carried on extensively in various parts of the United States, has never attained large proportions in Canada. The only plant in active operation is that at Radnor Forges, in Quebec. Many years ago smelting works on a small scale were started at Marmora and in Algoma in Ontaro, and there was also a small plant near Woodstock, N.B. At that time the market for such iron was comparatively limited in Canada and there were other obstacles which discouraged the promoters. The undertaking at Marmora has revived several times, but the promoters met with severe losses and were obliged to abandon it. Although Canada has such vast areas of wooded lands and though in many parts of the country there are extensive deposits of iron ore, it is somewhat surprising that capitalists, during the past twenty years, have so little directed their attention to the smelting of iron by means of charcoal. The iron thus produced is almost indispensable in several lines of manufacturing and there is a market for it in Europe as well as on this continent.



THE DESERONTO IRON CO.—MAIN BUILDING AND FURNACE—VIEW FROM THE BAY.



THE DESERONTO IRON CO.—THE ORE DOCK AND TRESTLE.

The location of the new charcoal iron smelting plant at Deseronto,

Ont., is primarily the result of a plan formed by the late H. B. Rathbun, founder of Deseronto, and his sons, E. W. Rathbun and the late F. S. Rathbun. They early conceived the idea of turning to account the waste material of their saw mills, and founded several factories with that end in view. To this end gas works for the conversion of sawdust into gas were started. The town was illuminated in this way for one year, but it was found to be unprofitable and afterwards the manufacture of fire proofing terra cotta was entered upon. Wood distillation was, after a number of costly experiments, made a success, and has been carried on for several years, the charcoal being exported to Detroit for the smelting works in that city E. W. Rathbun, general manager of the Rathbun Company, entered into negotiations with the Gaylord Iron Company, Detroit, and other United States' capitalists, and after some years succeeded in enlisting their active co-operation. The wood distillation plant of the Standard Chemical Co., which was described in a recent issue of THE CANADIAN ENGINEER, will produce the necessary charcoal for the smelter. Even at the present contemplated output of 12,000 tons of iron per annum, the wood distillation plant, in order to furnish the necessary charcoal for the smelting, will require annually about 20,000 cords of coarse timber. The supplying of this material will furnish employment, during the cold weather, to at least 200 men and 80 teams of horses. In addition to these are the hands employed in the transportation of this wood by water and rail. The works are situated in the west end of the town south of Main street and directly on the shore of the Bay of Quinte. The line of the Bay of Quinte Railway has been extended to the works, thus giving connection by rail and water. The ore dock has three hoists for lifting the ore from the holds of vessels, and with a trestle and tramway for carrying the ore to the piling ground adjoining the furnace. The accompanying cut will give the reader a good idea of the dock and trestle. The works cover an area of four acres of ground.

The plant and works were erected under the supervision of M. C. Furstenau, C.E., Detroit. F. B. Gaylord is general manager of the Deseronto Iron Co. Miss Sherwood is assayer and chemist. Felix de Claqui is the engineer, and Stephen Fallon founder.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

Toronto C.A.S.E., No. 1, met Feb. 1. A committee was appointed to look after the interests of those applying for the situation of engineer at the new Toronto municipal buildings. The following resolution was passed: "That the members of Toronto No. 1, C.A.S.E., deeply deplore the loss of life and personal injury to the innocent victims who suffered at the recent boiler explosion at the ice house in the east end of the city; and as a body of engineers wish to place ourselves upon record as concurring with the verdict of the coroner's jury which clearly set out the fact that the man in charge was incompetent; and that all boilers should be under the charge of practical engineers who have certificates, and that each boiler be inspected yearly by some competent person."

The annual At-Home of Toronto No. 1, C.A.S.E., will be held on Wednesday, Feb. 15th. A fine programme has been prepared and anyone going will be assured of a good time.

At the regular meeting of Hamilton No. 2, Jan. 3rd, after the formal part of the proceedings, the question box was opened and the "Vacuum" discussed. Much gratification was expressed at the election of Ald. R. C. Pettigrew, who headed the polls at the January elections and is one of the hardest working members of Hamilton No. 2.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

ANNUAL MEETING IN MONTREAL.

The thirteenth annual meeting of the Canadian Society of Civil Engineers was held at the society's rooms, 112 Mansfield Street, Montreal, opening on the 10th and closing on the 13th of last month. The attendance was unusually good and the convention, taking all its features together, was the best in the history of the society.

Among those present, on one or more days of the convention, were the following: K. W. Blackwell, Prof. C. H. McLeod, William McNab, H. Irwin, J. G. G. Kerry, Prof. John T. Nicholson, Dean Bovey, E. P. Hannaford, J. H. Parent, William Kennedy, Junior, Geo. Holland, E. A. Rhys-Roberts, M. Perrault, O. Arcand, L. A. Amos, F. P. Shearwood, W. C. Thompson, A. Massey, J. M. McCarthy, L. B. Copeland, J. H. Walters, J. S. Vindin, T. W. Lesage, G. H. Duggan, Stuart Howard, Ernest Marceau, W. McLea Walbank, Joseph W. Heckman, N. Hanson Greene, W. J. Sproule, F. C. Laberge, L. J. Marion, C. R. Coutlée, C. de B. Leprohon, Chas. S. Leach, H. Y. Bertrand, G. Legrand, W. A. Sanders, Duncan McPherson, A. Dedman, A. J. Bachand, L. S. Pariseau, Lewis Skaife, Frank S. St. George, L. G. Papineau, J. A. U. Beaudry, Dr. J. B. Porter, A. J. Corriveau, G. H. Garden, G. L. Mattice, Carl Reinhardt, L. F. Gagnon, L. A. Dufresne, James Ewing, J. G. MacGregor, J. P. B. Casgrain, R. W. Leonard, all of Montreal; W. T. Jennings, Willis Chipman, E. H. Keating, C. H. Rust, Henry A. Gray, Henry J. Duck, F. L. Somerville, H. Lindsay of Toronto; J. W. Fraser, A. St. Laurent, F. W. Cowie, Robt. Surtees, J. T. Farmer, Wm. Crawford, A. H. Bruce, G. A. Mountain, W. B. Anderson, G. H. Pinhey, of Ottawa; Henry O'Sullivan, Owen O'Sullivan, Thomas Breen, L. A. Vallee, Charles Baillairge, F. X. Berlinguet, of Quebec, R. Adams Davy and G. J. Desbarats of Iroquois, Thomas Monro, Coteau Landing; F. G. Butler, Napanee Mills; C. H. Ellacott, Westmount; B. J. Saunders, Ft. William; F. P. Strickland, Sydney, N.S.W.; J. S. Armstrong, St. John, N.B.; H. T. Hazen, Ste. Anne de Bellevue; R. and W. Russell, Pembroke; Rich. T. Gough, Halifax, N. S.; J. S. Bertrand, Fraserville; Wm. Burns, Renfrew; G. K. Addie, Sherbrooke; R. B. Rogers and W. J. Francis, Peterboro; M. J. Butler, Deseronto; E. G. Matheson, Charlottetown, P.E.I.; Geo. A. McCarthy, Moncton; N. E. Brooks, Calgary; J. D. Barnett, Stratford; Henry Zlapka, Hamilton; Prof. W. R. Butler, Kingston; Armitage Rhodes, Quebec; Geo. E. Thomas, Chicago; E. Berryman, Winnipeg; P. S. Hildreth, of R. W. Hildreth & Co., New York; Kenneth Moodie, Chicago; C. H. Osler, F. G. B. Allan, Napanee Mills.

The chair was occupied by K. W. Blackwell, vice-president, who calling the meeting to order, read a letter from W. G. N. Thompson, the president, regretting his inability to attend, owing to the illness of members of his staff.

The secretary, Prof. C. H. McLeod, read the programme of the meeting and then read the minutes of the last annual meeting, which were confirmed.

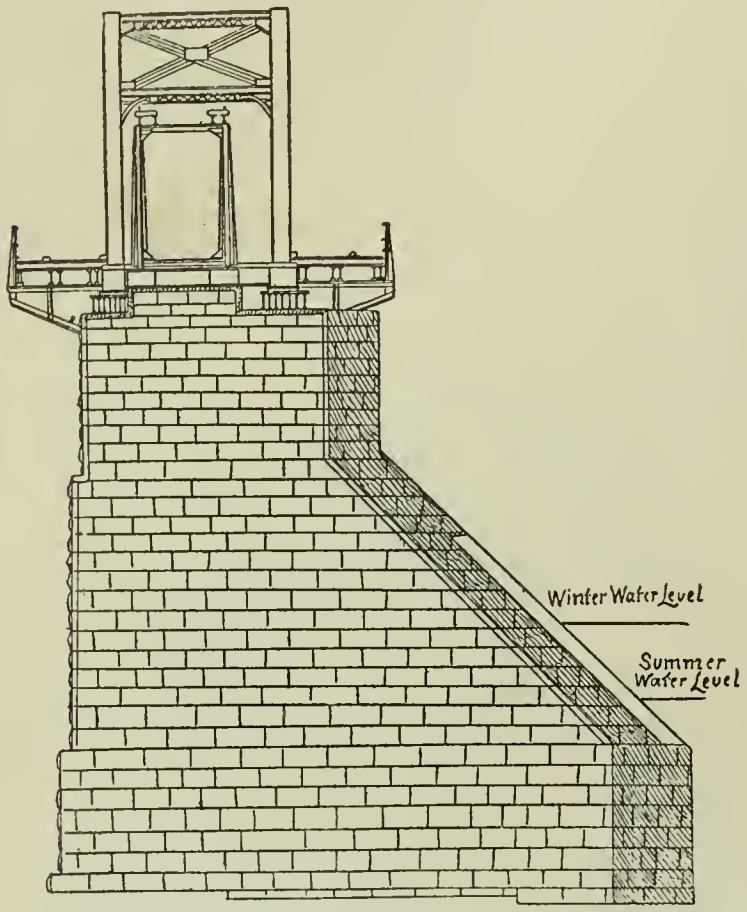
Messrs. F. W. Cowie, L. Skaife and Frank St. George were appointed scrutineers of the ballot for the election of officers and members of the Council; while Messrs. J. W. Heckman, C. de B. Leprohon and Geo. A. McCarthy were appointed scrutineers for the Nominating Committee.

The chairman announced that the Grand Trunk Railway Company had extended an invitation to the members to visit the new Victoria Jubilee Bridge, and that a special train would await the party at Bonaventure Station at 2 o'clock. The meeting then adjourned and in the afternoon a large party took advantage of the Grand Trunk's courteous offer. The day was very cold and a keen wind swept across the river, raising wreaths of steam over the only unfrozen spot in the St. Lawrence, just at the big central span, where the party halted. General admiration was expressed at the excellence of the bridge-work and masonry, and the skill that had been shown in surmounting the special problems of construction presented in replacing the former tubular structure by this famous bridge. After inspecting the features of the great central span the visitors were taken to the St. Lambert end, so that on their return they could admire the approach to the city from the bridge. They were highly pleased with the trip, notwithstanding the zero temperature of the day. Joseph Hobson, Chief Engineer of the Bridge and of the Grand Trunk Railway System, acompanied the party, and explained many important details of the works.

The evening was pleasantly and profitably taken up with a general description of the Bridge, by Wm. McNab, Librarian of the Society, and assistant engineer of the Grand Trunk Railway System. The chairman first announced that a detailed account of the new bridge was being prepared by Joseph Hobson, Chief Engineer, and this description would be incorporated with the Society's Transactions of the current year.

The rooms were crowded, a large number of ladies being present, and Mr. McNab's address, aided by the stereopticon, in charge of F. R. Redpath, was most instructive. In beginning his description Mr. McNab remarked that no bridge of that period attracted as much attention throughout the world, or commanded as much admiration as the Victoria Tubular Bridge at Montreal, which was erected between the years 1854 and 1859. When it was recollected that there were few precedents for the engineers to go upon in regard to many important matters, and that some of the difficulties to be overcome were here presented for the first time, and on such a great scale, we are bound even now to acknowledge the foresight and skill displayed by its designers and builders. The Victoria Bridge consists of 24 spans, varying from 242 feet to 248 feet in length, in the clear, and a centre span of 330 feet in the clear. The capacity of the old bridge was thought ample for all the traffic that would ever pass over it, and certainly no one could have thought that within thirty-eight years from its completion they would need the double track structure which the traffic of the present day requires. The engineer at that time had difficulty in making up a train weighing one ton per lineal foot, and to do it he had to put on three locomotives, and a specially loaded

train. The new bridge is designed to carry a moving load in either direction, on each of the two tracks, consisting of two consolidation engines and tenders, followed by a uniformly distributed load, weighing 4,000 lbs. per lineal foot; also a moving load in either direction on each of the extended roadways of 1,300 lbs. per lineal foot. In the new structure provision is made for two tracks, which may be used both for steam traffic and for electric railways, and a vehicle and a foot passenger roadway is provided on each side, outside of the main trusses, formed by an extension of the great floor beams. This is shown in the accompanying diagram. So liberal had the original



THE JUBILEE VICTORIA BRIDGE—PIER AND SECTION OF SPAN.

engineers been in the design of the capacity of the piers, that none of the foundations had to be extended, or even touched. All that was required was the extension of the masonry on the upper ends of each pier, by building up over the saddle of the cut water. This extension was about seven feet, and as there was no place below to pile the stone, the material for this addition had to be let down by a traveler working on top of the old tube. Each course of masonry was exactly the same thickness as the course in the old piers, of which it formed an extension, and each joint was made to overlap that on each course next below by twelve inches. The stones of each course were clamped together by clamps turned down 2½ inches, and embedded in the stone, there being both vertical and horizontai clamps. The stones were set in the most approved manner, and the pointing and grouting received the best treatment. Mr. McNab gave an interesting explanation of each picture thrown on the screen, showing the method of carrying out the pier beams and floor beams, the erection trusses, the method of placing the temporary cantilever spans to connect with the centre erection truss used on the big centre span; but as these will be described in detail in Mr. Hobson's forthcoming paper, they are not fully described here. For the building of the steel superstructure a sorting yard was laid out at each end of the bridge and the various bridge members were piled in the order in which they were to be used, the heavy members being placed under the great traveling crane, and the lighter ones outside the track, and handled by its cantilever arms. As the traffic had to be maintained while rebuilding, and false works in the river were out of the question, the idea of the traveling erection truss was adopted. These trusses, of which there was one on each side of the centre, were of the exact length of the small spans of the bridge, and were a little greater in width than the old tube, and a little less than the permanent truss of the new bridge. The pier beams were placed in sets of seven, one set on each side of the tube, and were lowered to place by means of a hoisting engine. Each set weighed seven tons After the pier beams were placed, the end floor beams were riveted to them by web connections, and thus bound this part of the work both transversely and longitudinally, and distributed the weight uniformly over the piers.

The erection truss was traveled from pier to pier by means of a series of trucks moving on the rails or top of the tubes. Wooden blocking was placed on these trucks to carry the truss by means of its top members, and the wheels were so placed as to distribute the weight as uniformly as possible in passing over the tube, and it really strained the old tube less thon did the ordinary train traffic. The truss was drawn across each span by means of block and tackle, worked by a stationary engine securely placed on top of the next tube.

As instances of how perfect the arrangements were for the moving of the temporary truss, it may be stated that the time occupied in the actual passage from pier to pier, was only from 4 to 6 minutes. After the truss had been placed exactly over its bearings on the piers, it was lowered in place, and the entire weight removed from the tube. The aggregate time for each span connected with the moving of the temporary truss and lowering it to its bearings, was only about half an hour. One erecting truss worked from each end towards the central span, upon reaching which the central erection truss was formed by the two trusses on an ingenious modification of the cantilever principle. From the 23rd March to 19th August, twenty-four spans were assembled and put in position. In removing the old tube, the body was removed in sections small enough (about 7 ft. x 18 ft.) to be handled and placed on the cars, and disposed of so as not to interrupt the daily traffic.

Pneumatic chisels were used to take the heads off of the rivets, and pneumatic hammers for backing the rivets out. In removing some of the bottom pieces a rail saw was used. The spans were adjusted to permanent level by hydraulic jacks of commensurate capacity. Mr. McNab's instructive sketch closed with pictures of the end view and a general view of the magnificent structure as it now appears.

The lecture was heartily applauded, and at its conclusion, E. H. Keating, of Toronto, proposed a vote of thanks to Mr. McNab. Mr. Keating said he was intensely interested in this great work, which was formerly reckoned one of the wonders of the world, and if it was so regarded then, what would its designers think of the remarkable work of its present reconstruction, in which problems then considered insoluble were carried out. Great credit was due to the engineers who designed it and the contractors who carried it out.

Charles Baillairge, of Quebec, warmly seconded the motion and said he had been greatly impressed, on their visit this afternoon with the beautiful outlines of the bridge, as well as its great strength and solidity. A heavy train passed along while he stood on the bridge, but hardly the least tremor could be felt. There were other great bridges in the world such as the Forth, the Menai and Brooklyn bridges, but in some respects, the Victoria was still the greatest structure of the kind in the world.

On motion of J. D. Barnett, of Stratford, a vote of thanks was also passed to Mr. Redpath for his good management of the lantern slides.

Prof. Bovey took occasion to refer to the great skill shown by Mr. Hobson in connection with this and other engineering works carried out for the Grand Trunk, and he regarded the present structure as one of the engineering triumphs of the Jubilee reign of Queen Victoria. He then gave a general invitation to the visiting members of the society to inspect the applied science departments of McGill University.

An interesting fact connected with the visit to the bridge was that John Duckworth, whom they all had met on the bridge that afternoon, had been inspector of the old tubular bridge since it was originally opened for traffic, and he it was who handled the implement which held the last rivet whilst the Prince of Wales drove it "home," at the inauguration of the bridge in 1860.

After partaking of light refreshments in the adjoining rooms the first day's proceedings closed.

WEDNESDAY, JAN. 11TH.

This day was very pleasantly taken up by an excursion to the works of the Laurentide Pulp Co. at Grand' Mère. Sir William Van-Horne, who is president of the company, had a train of parlor cars placed at the service of the society for the day, and the large turn-out of the members showed that the courtesy was fully appreciated. The five cars were quite filled when a contingent from Quebec joined the party at Three Rivers. The train left Montreal about 8.30 a.m, arriving at Grand' Mère about 12.30. On alighting they were met by Russell A. Alger, Jr., son of the Hon. Russell A. Alger, and secretary of the company, who with H. Meurer, manager of construction, and other officers of the company, showed the visitors over the great works which have created around them a town of 3,000 where there was only a hamlet when the mills began operations. When the falls from which the great water power is derived were visited by the French settlers, the contour of the projecting rocks showed the profile of an old woman hence the name it acquired of Grand' Mère (grandmother). This rock was blasted away in forming the dam, but the name still survives, maintaining the natural relation between grandmother and dam. The falls are capable of yielding 70,000 h.p. at low water and 90,000 h.p. at high water. About eight hundred hands are employed in these mills, besides 1,400 outside who are engaged in getting out the wood from the forest. The pulp wood pile at the mills covers more than an acre, and in some places is piled to the height of 30 or 40 ft., making about 80,000,000 of lumber

measurement. These mills produce paper, card-board and pulp for export, and the daily capacity of the three departments is as follows — 40 tons of paper, 35 tons of cardboard, 110 tons of mechanical fiber (pulp), and 70 tons of sulphite fiber. There are 30 pulp grinders, three digesters, 45 ft. in height by 14 ft. diameter, one 112-inch Fourdrinier machine, one 90-inch machine and one board machine. In total capacity it is the largest mill in Canada, and one of the large paper and pulp mills of the world. After showing the party through each department the management of the mill invited their visitors to a luncheon served on improvised tables with big sheets of card-board for table-cloths, and heaped with huge turkeys, hams, ribs of beef and the kind of accompaniments which were most appreciated on a cold day. From the appearance of the tables after the lunch was over the managers could have had no doubt of the enjoyment of their guests. After thanking their hosts the party returned to the train and arrived in Montreal about 9 p.m.

Among the members and friends attending the excursion whose names have not been already mentioned were the following: R. C. Alexander, H. B. Sims, W. F. Angus, J. Ewing, J. W. Brock, J. F. Ellis, J. A. Burnette, R. Kenrick, R. F. Gough, A. Burnette, B. A. Davis, W. M. Young, J. C. Denis, R. S. Lea, E. G. Coker, J. P. B. Casgrain, J. H Larmonth, E. A. Stone, S. H. Capper, G. Taylor, H. R. Ives, and J. T. Shearer.

THURSDAY, JAN. 12TH.

The meeting was called to order at 10.30 a.m., the chair being taken by G. H. Duggan, who called on Thomas Monro to read his paper on "The Soulanges Canal," which, with the discussion on it, will appear in another issue.

At the afternoon session, when J. D. Barnett presided, a paper on the Trent Valley Canal was read by R. B. Rogers, engineer-in-charge of that work. A summary of this paper will be given in a later issue.

In the absence of H. K. Wicksteed, the chairman called on G. A. Mountain to read that gentleman's paper on the Georgian Bay and Ottawa Ship Canal, which is summarized in another part of this issue.

In moving a vote of thanks Ernest Marceau expressed the hope hat this great scheme would be carried out at no distant date.

In seconding the motion, which was carried, J. S. Armstrong said he looked upon it as a work of great importance to Canada at large and to Montreal in particular.

FRIDAY, JAN. 13TH.

At the morning session the chair was occupied by Mr. Blackwell.

The secretary read the report of council for the past year, of which the following is a summary.

During the year eight members, twenty-one associate members, two associates, and twenty-two students were elected. Three associate members have been transferred to the class of member, and eight students to the class of associate member. One associate member and one student, removed from the roll for non-payment of dues, have been re-instated upon payment of their arrears. The elections under the Quebec Act, Vic. 61, Chap. 32, comprised four members, fifty associate members, and one student. Five students were admitted as associate members under the Quebec Act. Resignations have been received from two members, two associate members, one associate, and one student. The deaths have been: Of Honorary Members—Sir John Fowler, Bart., K.C.M.G., LL.D.; of Members—Col. Sir C. S. Gzowski, A.D.C., K C.M.G.; William Kingsford, LL.D., and Joseph DeGurse.

At present the membership stands as follows:—Honorary Members, 7; Members, 294; Associate Members, 232; Associates, 41; Students, 142; Total, 716. At the same date last year the total membership was 628.

Eighty-seven applications for admission into the society are now pending, against nine at date of last annual meeting. The Act concerning Civil Engineers in the Province of Quebec became law on Jan. 8th, 1898. This Act is known as Vict. 61, Chap. 32, of the Statutes of the Province of Quebec. No further Legislative enactments have at this date been obtained. In the Province of Nova Scotia an Act was brought before the Provincial Legislature during its last session, but, owing to local conditions, was not passed. In the Province of Ontario several conferences have been held with the Ontario Land Surveyors, and the Provincial Committee has drafted a bill based upon the Quebec Act and corresponding to it in essential features, which it is hoped will meet with the approval of the Government and become law during the next session. The committees in charge of legislation are as follows:— Central Committee.— P. W. St. George, W. J. Sproule, H. Irwin and C. H. McLeod.

Nova Scotia.—M. Murphy, C. E. W. Dodwell, W. G. Matheson and H. S. Poole.

New Brunswick.—Hurd Peters, P. S. Archibald and H. R. Lordly.

Quebec.—St. George Boswell, L. A. Vallée, E. Marceau, T. Breen and J. M McCarthy.

Ontario.—W. Chipman, A. L. Hertzberg, M. J. Butler, E. H. Keating and C. H. Rust.

Manitoba.—H. N. Ruttan, G. H. Webster and J Woodman

N. W. Territories.—W. D. Barclay, G A. Stewart and W. T. Thompson.

British Columbia.—H J. Cambie, A. J. Hill, H. Abbott, F. C. Gamble and E. A. Wilmot.

The Council desires to point out that hereafter, all persons desirous of practising as Civil Engineers in the province of Quebec should become members of the society under the provisions of the Quebec Act, *i.e.*, they should pass the examinations therein prescribed and otherwise conform to the requirements of the Act. In accordance with the requirements of the Act a Board of Examiners has been constituted as follows: E. Marceau, R. J. Durley, T. Breen, C. H. McLeod, R. S. Lea and Prof. F. S. Duval. No examinations have yet been conducted, as no candidates have applied for admission except under Articles 2 and 3, which provided for practising engineers and land surveyors joining during the year 1898. This avenue of access to the society is now closed, except as regards provincial land surveyors, who were practising at the time of the passing of the Act.

An employment registry is now kept in the Society's rooms for the benefit of members. The president and secretary of the Institution of Civil Engineers extend a welcome to their institute to members of the Canadian Society who may be visiting the next World's Fair in Paris. Reference was made to the death of Sir Casimir Gzowski, who was founder of the only medal in the gift of the Society. Attention was called to the fact that the by-law fixing the admission fee at $20 was now in full force. Under the Quebec Act the fee for students is $20, and for associate members $40.

The report of the Library Committee by Wm. McNab, librarian, showed that this Committee had held five meetings during the year. The reading rooms are now well supplied with technical journals, and during the year a good many donations of books were received.

The following was the treasurer's statement:

Balance from 31st December, 1897		$6,970 65
GENERAL RECEIPTS.		
Subscriptions:—		
Arrears	$1,287 15	
Current	2,351 26	
Advance	749 66	
	$4,388 07	
Transactions sold	17 50	
Dividend on Canada Permanent Loan Co.'s stock	4 50	
Donations to Library	26 16	
Donation towards expense of Annual Meeting	2 00	
Bank interest on current account	46 99	
Bank interest on deposit account	111 81	
		$4,597 03
BUILDING FUND.		
Balance from 31st December, 1897	4,026 03	
Ketchem bequest transferred from general fund	500 00	
Interest to 31st December, 1898	130 70	
		4,656 73
		$16,224 41

GENERAL EXPENDITURE.

Transactions printed and published	$ 897 10
Advance proofs	66 54
Printing, stationery and binding	267 95
Charter, By-laws and List of Members	85 25
Postage and post cards	176 98
Messengers and telegrams	29 41
Cabs, cartage, etc	8 70
Secretary's salary, including 7 months of 1897	475 00
Assistant secretary's salary for year	488 07
Caretaker's wages for year	140 00
Caretaker for washing towels	6 00
Cost of keeping rooms open at night	62 00
Rent of rooms for year	675 00
Telephone service, including 6 months of 1897	45 00
Bank commissions on cheques	13 22
Water rates	25 22
Electric lighting for year	76 69
Books and magazines and library expenses	95 30
Expenses *re* Close Corporation	863 83
Expenses at meetings	20 75
Engrossing diplomas	22 50
Gzowski medal and engraving	11 48
Office furniture and alterations	609 38
Rent of drawer in bank vault for year	5 00
Amount transferred to building fund	500 00
Gas for grate fire	2 00
Treasurer's expenses, car fares, etc	4 34
Petty cash in hands of Asst. Secretary	1 75
	$5,674 46

BALANCES.

General Fund Treasurer	$5,893 22	
Building Fund Treasurer	4,656 73	
		$10,549 95
		$16,224 41

H. Irwin, Treasurer.
K. W. Blackwell, W. McLea Walbank, Auditors.

On motion of J. M. McCarthy, seconded by Lewis Skaife, the reports were adopted,

The question of the removal of the Society's quarters and the project of purchasing a building for the Society's exclusive use led to a long discussion. The secretary explained that the owners of the present building, the Bank of Montreal, had declined to make certain small alterations to improve the lighting of the entrance, but instead proposed to allow the Society to do it, deducting the cost from the rent, but holding the Society responsible for any damage to the building. The Council did not wish to be put into a trap of this kind, and as the defect was caused by the owners blocking up the natural light at the rear they considered they were entitled to have the defect remedied without being held liable to possible damages in making the necessary changes. The discussion was resumed at a later stage, when E. P. Hannaford, who took strong ground in favor of remaining in the present rooms, moved that the present rooms be secured for a period of 3 to 5 years, and that the Council be instructed to arrange terms with the landlords.

This led to a discussion of the policy of purchasing a building or erecting one for the Society's future use. Several members expressed themselves in favor of building or purchasing, but others while in favor of the policy of having a home for the Society, thought the condition of the Society's funds did not justify the step at the present time. Messrs. Skaife, Leprohon, Vindin, and Lesage had been appointed a committee to investigate the question of new temporary rooms, and this committee now reported that two fairly suitable properties could be purchased, one in Osborne street, at $14,000, and the other in Union avenue, at $18,000. The annual cost of the former was computed at $810, and of the latter $875. The rent of present buildings is $700. After discussion Mr. Hannaford's motion was defeated, and a motion by J. M. McCarthy, seconded by C. H. Rust, was carried, leaving the whole question in the hands of the Council.

Several members desired a definition of the society's policy on the building question and this was put on record by two resolutions, the first by Wm. Kennedy, seconded by J. M. McCarthy, stating that in the opinion of the society it was not advisable to build or purchase permanent quarters at the present time, and the second, proposed by Lewis Skaife, seconded by W. B. Anderson, that it is the policy of this society to purchase a building as soon as the state of the funds shall warrant such action.

Mr. Chipman suggested that the treasurer's statement should hereafter be drawn up in the form of a balance sheet designed to show more clearly the assets and liabilities of the society for the benefit of outside members.

Mr. Jennings and others agreed with this suggestion.

The committee on the Civil Engineer's Bill for Ontario, consisting of W. T. Jennings, A. L. Hertzberg, C. H. Rust, E. H. Keating, M. J. Butler and Willis Chipman, then presented their report through the last-named gentleman, who was chairman. Mr. Chipman read the draft of the proposed act, which was based largely on the act passed by the Manitoba Legislature in 1896 and the Quebec Legislature in 1897, which established the qualifications necessary to permit persons to practice as civil engineers in those provinces. By those acts no person can practice engineering in the province unless he is a member of the Canadian Society of Civil Engineers. In Ontario it is proposed, however, to allow engineers who are now practicing to continue to do so without joining the society, provided they are qualified as engineers. The Ontario Act provides that any member who so desires, may at any time withdraw from the society and have his name struck off the register and may join again if he wishes to resume practice. Much more latitude is allowed the board of examiners under the Ontario bill than under the Quebec Act, and provision is made for consulting engineers from abroad.

On motion of Stuart Howard, seconded by Lewis Skaife, the committee on this bill was continued for the present year.

The committee on Standard Measures, which had no report to present, was also continued in office.

The committee on the Gzowski medal award recommended that the medal for the best paper for the past year be awarded to John Taylor Farmer for his paper on "Impulse Water Wheel." The announcement was received with applause.

A letter was read from the Association of Architects of the Province of Quebec, calling attention to a provision in the amended charter of Montreal, that the Board of Expropriation should consist of five men, namely, one lawyer, one architect, one civil engineer, one contractor and one real estate man, each of whom should have been at least ten years in practice.

The secretary called attention to the fact that a member had paid in to his assistant $8 without leaving his name. The member in question did not reveal himself.

The following was the result of the ballot for the election of officers for 1899:

President—W. T. Jennings, Toronto.

Vice-Presidents—P. W. St. George, Montreal; K. W. Blackwell, Montreal; and E. H. Keating, Toronto.

Treasurer—H. Irwin, Montreal.

Secretary—Prof. C. H. McLeod, Montreal.

Librarian—Wm. McNab, Montreal.

Council—G. H. Duggan, Montreal; John Kennedy, Montreal; Thos. Monro, Coteau Landing; H. N. Ruttan, Winnipeg; C. H. Rust, Toronto; G. A. Monntain, Ottawa; Duncan MacPherson, Montreal; C. E. W. Dodwell, Halifax; St. George Boswell, Quebec; W. B. McKenzie, Moncton; Ernest Marceau, Montreal; Willis Chipman, Toronto; John Galbraith, Toronto; Stuart Howard, Montreal; G. A. Wilmot, Victoria.

The Nominating Committee was as follows: For Quebec, H. Irwin and Stuart Howard; for Ontario, C. H. Rust, John Galbraith and E. H. Keating; for the Maritime Provinces, Dr. Martin Murphy; for the Northwest Provinces, H. N. Ruttan; for non-residents of Canada, W. J. Sproule.

Scrutineers—J. W. Heckman, Geo. A. McCarthy and P. de B Leprohon.

After luncheon, the retiring president's address was read by the secretary, and a vote of thanks was passed to the scrutineers.

W. T. Jennings, the president elect, was then moved to the chair. In thanking the members for the honor they had conferred on him, Mr. Jennings said that though he had been a member of the Society since its organization, he had unfortunately not been able to be present at many of the annual meetings, and had therefore never taken a prominent part in its proceedings. He had, however, always taken a keen interest in the progress of the Society and he should now feel bound more than ever to promote its prosperity and help to obtain the corporate rights which the Society desired. He urged members to contribute to the stock of knowledge of the Society, especially by papers and by monographs, relating their experience in pieces of work out of the common. He hoped the members would not be found working as cliques, but would remain united in the broad interest of the Society.

On motion of Lewis Skaife, seconded by P. de B. Leprohon, it was decided to print the Quebec Act in the next issue of the transactions.

It was moved by J. M. McCarthy, seconded by W. J. Sproule, that in view of the fact that it is the settled policy of this society to establish one civil engineers' society for the whole of Canada, which shall include all branches of the art, this council be instructed to draw the attention of the universities to the entirely different signification of the term "civil engineer" as employed by them, and as understood by this society, and request them to consider if they cannot arrange to use the term only with the full signification given to it in the charter of this society.

Mr. Jennings pointed out that last year Toronto University conferred its degree in civil engineering on a new plan, and that body not only conformed to the standard of this society, but appointed a member of the society as its own examiner in civil engineering.

It was moved by W. J. Sproule, seconded by Lewis Skaife, that it is expedient that a representative committee be appointed at this meeting to enquire into the question of the official appointment of engineers with a view to attaining uniformity in the designation of engineers, so that the terms "Chief Engineer," "Assistant Chief Engineer," "District Engineer," "Divisional Engineer," etc., may have the same definite meanings as nearly as possible, and that this committee report to the next annual meeting. Carried.

On motion of G. H. Garden, seconded by J. M. McCarthy, a vote of thanks was passed to the Grand Trunk Ry., and on motion of Mr. McNab, seconded by J. G. G. Kerry, a vote of thanks was passed to the C. P. Ry., for the courtesies extended to the society by those corporations.

On motion of Wm. Kennedy, seconded by J. G. G. Kerry, a vote of thanks was passed to the Laurentide Pulp Co. for the company's hospitality to members on their visit to Grand' Mere.

On motion of C. de B. Leprohon, seconded by W. J. Sproule, it was decided that the Nominating Committee be furnished with a note of the attendance of members of Council during the year, with explanations of the cause of absence of members from the meetings.

On the suggestion of Mr. Irwin it was decided to address a letter to Thos. C. Keefer and Walter Shanly conveying the good wishes of

e society to those veteran members, and regrets that they were not able to be present.

The meeting closed with votes of thanks to the officers for their services during the year.

The annual dinner of the Canadian Society of Civil Engineers was held on the evening of Thursday, 12th Jan., at the Windsor Hotel, and was voted to be one of the best, if not the very best, since the society was established.

K. W. Blackwell, Vice-President, presided, and made an excellent chairman. On his right were W. T. Jennings, President-elect, Prof. S. H. Capper, E. P. Hannaford, Louis A. Vallee and Charles Baillairge, and on his left were Thos. Monro, Dean Bovey, C. W. Spencer, Edw. J. Featherstonhaugh and Major Henry A. Gray. Among the other guests present were: Henry O'Sullivan, Owen O'Sullivan, R. W. Leonard, J. A. Marion, J. A. G. Goulet, R. S. Lea, J. M. McCarthy, J. P. B. Casgrain, F. W. Cowie, A. Boyer, J. G. Macklin, Wm. McNab, W. J. Francis, Geo. E. Thomas, Henry F. Duck, C. H. Rust, M. J. Butler, R. B Rogers, L. B. Copeland, Wm. I. Bishop, L. M. Lovelace, H. Lindsor, R. P. Rogers, W. R. Butler, Jos. W Heckman, J. G. Armstrong, R. Adams Davy, G. J. Desbarats, G. H. Garden, Robt. Surtees, Wm Kennedy Jr., F. X. Berlinguet, J. G G. Kerry, Owen N. Evans, H R. Ives, G. A. Mountain, Duncan McPherson, Arthur H. N. Bruce, T. P. Shearwood, H. L. St. George, J. E. Dore, R. F. Ogilvy, Jas. H. Parent, John H. Walters T. W. Lesage, E. A. Rhys-Roberts, J. S. Vindin, C. de B. Leprohon, Lewis Skaife, Frank T. St. George, N. E. Brooks, B. J. Saunders, Wm. P. Anderson, Prof. C. H. McLeod, Willis Chipman, J. Atkinson Douglas, Maurice Perrault, H. Irwin, Stuart Howard, G. H. Duggan, James Traill Shearer, and E. B. Biggar, of the CANADIAN ENGINEER, and members of the local press. The dinner was good, and the arrangements reflected credit on the Dinner Committee, which consisted of Messrs. Frank St. George (chairman) J. G. G. Kerry (sec.), C. H. McLeod, H. Irwin, Wm. McNab and C. de B. Leprohon.

After the "Queen" had been loyally drunk the chairman proposed the "Sister Societies," and in doing so spoke of the progress of learned societies in recent years, a progress greatly accelerated by unity of action and exchange of knowledge He alluded to the presence of members of the Quebec Association of Architects, and coupled the name of Prof. Capper with the toast. Prof. Capper, in responding, said he did not know why his friend Mr. Kerry had selected him to reply to this toast. Everybody knew an architect was a man who ought to be an engineer, but is not; and as to mining, which he was also expected to include, the only thing he remembered about it was the unmitigated pleasure it gave him to get up again out of a mine after having got down into it. However, it did not matter how many subjects his reply should include—which reminded him of the story of a lady who was travelling on the Great Western Railway, of England, and who resented the intrusion of a strange gentleman in the compartment. "Sir," she demanded, as the gentleman persisted in keeping his seat, "do you know who I am?" "Madam," he replied, "I haven't the faintest idea." "I," said the lady haughtily, "am one of the directors' wives!" "Madam," he returned, coolly, "it would not have made the slightest difference if you had been the director's only wife." Prof. Capper made a number of witty hits and was well received. Stuart Howard then sang "Soldiers of the Queen," and was heartily applauded. The chairman proposed the Corporations to whose courtesies they were indebted for their entertainment, especially the two railway companies who had provided the excursions. C. W. Spencer, of the C P.R., in response said the engineers had performed their part in the evolution of railways, for if it were not for them the railways would not exist. As for the excursions, it had given the companies more pleasure in providing them than it had given their guests in participating in them. Mr. Lesage gave Sir Geo. Cartier's song "O Canada Mon Pays Mes Amours" in very good style. The toast of Visiting Members was coupled with the names of Chas. Baillairge of Quebec, and J. S. Armstrong of St. John, N.B Mr. Baillairge said the warmth of the reception given the visiting members made up for the coldness of the atmosphere. It had been said that there was no beauty in engineering, but a man who stood on the axis of the new Victoria Bridge and viewed its magnificent proportions and immense perspective must be fascinated by the sight. We must not forget that it was a Canadian engineer, T. C. Keefer, who selected the site and laid out the work, and so well was it done that the engineers of the new bridge were enabled to rebuild it without altering the foundations at all. He made some interesting comparisons of this bridge with that of the Forth and Menai bridges; and then gave an account of the St. Charles Aqueduct at Quebec, which he had built, and around which they had erected a bridge without turning off the water. He threw two pipes across the river in the form of an arch, so that if the protecting boxes were destroyed the tubes would be self-sustaining. These two pipes were braced together so that the wind could not blow them over. To show how water may wear away iron he mentioned that a slight flaw in the pipe led to a small pin hole, which developed into a hole 2 inches in length, a result which might easily happen under a head of 486 ft. or a pressure of 2[illegible] lbs. per square inch. This society had given some light to the engineering world for one of its members had solved the mystery of the ball-nozzle, which was a puzzle to scientists for some time, and had also anticipated the investigations carried on at the Forth bridge, and at the Tower bridge in London, when it was found that the actual pressure of the wind fell short of the indications of the anemometer by 40 per cent. The explanation was due to the same principle in both cases—the back pressure caused by the vacuum formed by the on-rush of water or air. This Society had accomplished a good deal, and should be destined for a great career. Mr. Armstrong followed, and expressed his admiration of the great engineering developments of Montreal and its vicinity. With institutions like McGill University and the two great railway headquarters, there were many incentives to engineering activity, Montreal seemed destined to be the railway and canal centre of half the continent. In the east we have the city of St. John, with its open winter port and its ambition to cope with all the increased trade that must flow to the Atlantic. The C P.R. had done a good deal to second the efforts of St. John, and he was glad to see the G.T.R. pushing its way down to the picturesque city by the sea. We have possession there of the largest wet dock in the world, and with five miles of open water which never freezes, the city and port of St. John could look with every confidence to the future. Lewis Skaife sang Kipling's "Fuzzy-Wuzzy," winning hearty adplause The chairman then handed over the balance of the toast list to Mr. Kerry, to whose energy and thoughtfulness so much of the success of the dinner was due. Mr Kerry gave "Our Society," and then called on Dean Bovey, who pointed out that all our comforts in transportation were due to the engineer. With weather at zero we were now able to go from room to room, from street to street, from town to town, and from country to country, carrying our fires with us, and having our choice of coal, steam or electricity as the heating medium. He gave a sketch of the formation of the Canadian Society of Civil Engineers, much of the work of organizing which was done by the late Alan Macdougall. He hoped the time would come when one set of laws regulating the practice of civil engineers would apply to all provinces in the Dominion. Mr. Leprohon sang the "Deux Gendarmes," and received a hearty encore. Mr. McPherson gave an account of the work of the Council, on whom a great deal of detail labor fell. The Council, while willing to accept its responsibilities and shoulder the work, was also willing to listen to suggestions and get instruction from any member. Henry O'Sullivan, Inspector of Surveys for the Quebec Government, sang an amusing song, "The Old Irish Stew," to the tune of the Red, White and Blue, and supplemented his song with some interesting facts about the undeveloped resources of the Province of Quebec, especially those comparatively unknown northern regions where enormous water powers existed in close proximity to deposits of minerals and immense forests of spruce and other timber. Mr. Jennings, the in-coming president, was then called on, and congratulated the Society on the headway it had made He would see that no stone was left unturned to advance its interests. It only remained for the members to be loyal to each other. G. E. Thomas then gave a song which was much appreciated, and Mr. St George made a short but humorous reply to the toast of the "Ladies." Mr. Skaife proposed a bumper to Mr. Leprohon as acting chairman to dinner committee, and the company rose shortly after 12 o'clock with "Auld Lang Syne" and hands all round

William Tyndale Jennings, President for 1899, of the Canadian Society of Civil Engineers, was born in Toronto, 19th of May, 1846, his father being the late Rev. Dr. Jennings, pastor of the First United Presbyterian Church. He was educated at the Model Grammar School, and at the Upper Canada College. His professional career began in 1860, when he commenced field work under T. N Molesworth, engineer of Public Works, and brother of the well known compiler of Molesworth's Engineer's Pocket Book. After a year's work on the drainage improvements of the Crown lands of Ontario, under Mr. Molesworth, he entered the service of the Great Western Railway in 1870 under George Lowe Reid, chief engineer. After some experience in survey, location and construction work, he was appointed in 1873 resident engineer of the Air Line Division of the G W R., the London and Port Stanley and the Welland branches, under John Kennedy, chief engineer. During this time he made an exhaustive survey of the Detroit River, the company having in contemplation a bridge across the river near Detroit city. This was a joint enterprise of the G.W.R. and Michigan Central, but both it and the tunnel which had been constructed about half way from the American side, and for

about 500 feet on the Canadian side, in 1871, were abandoned Through the kindness of Messrs. Gzowski and McPherson, engineers and contractors of the international bridge at Buffalo, Mr. Jennings was allowed special facilities for studying all the details of that great work, and in his subsequent official positions, he was fortunate in being frequently sent on missions of investigation into new works to various parts of the continent, which enabled him to acquire a vast store of technical knowledge, of which he has been able to make good use in his professional work. In 1875 the work of construction on the G.W.R. being over, he gave up the position of resident engineer, preferring more varied work, and went into the service of the Dominion Government on the Canadian Pacific Railway under Sanford Fleming, chief engineer. He went to British Columbia as locating engineer on the B.C. Division, remaining there till 1879, and during that time, among other things, located the present line through the canyons of the Fraser River and other intricate sections. On completion of location he was

Yours truly
W. H. Jennings

moved to the Lake of the Woods as district engineer in charge of the heavy construction work from Rat Portage to Eagle River, 69 miles, and on the completion of that work returned to British Columbia, as superintending engineer for the Dominion Government under Collingwood Schreiber, Mr. Fleming having in the meantime retired. In 1882 he came east for a time on account of his wife's illness, and in the following year was offered an inspectorship of Government railways, but preferring more active work he returned to B.C. in 1883 as chief engineer for the Construction Company headed by A. Onderdonk, and acting manager during Mr. Onderdonk's absence. This work comprised 350 miles of the road from the Pacific Coast eastward, which was completed in 1885. He then took up work for the C.P.R. in Ontario, building the lines from Woodstock to London, from London to Detroit, the Wingham extension, the eastern entrance to Toronto, the Guelph Junction (as consulting engineer), and various locations of surveys, also the Toronto wharves of the C P. R. from Yonge Street westward. In 1890 he was offered the position of city engineer of Toronto, and having accepted it, reorganized the engineer's department for the city, and made many improvements of a permanent and substantial character, such as the Sherbourne street bridge, the Carlaw avenue, and King street subways (the last named from plans of his predecessor, Mr. Sproatt), the island ferry slips, etc. He also brought about a settlement in a dispute between the railway and the city as to the occupancy of the water frontage. The city having obtained the street railway franchise, released the same under specifications prepared by Mr. Jennings, which were so carefully drawn that they have formed the basis of many like franchises since obtained by large cities in the United States. About this time he was offered the chief engineership of the Public Works Department, but declined the offer, much to the surprise of many of his friends and of some members of the Government. Mr. Jennings gave up the office of city engineer, and entered into private practice in 1891, since when he has built the Niagara Falls Park & River Railway, the Galt, Preston and Hespeler Electric Railway, the Tilsonburg & Port Burwell Railway, and a number of other works of greater or less importance. From 1892 to 1895 he was chief engineer of the British Columbia Southern Railway, now better known as the Crow's Nest Railway, the route for which he examined and located in such a way as to open up to best advantage the enormous coal deposits which are now considered the key to the successful development of the mining interests of the Pacific province. In 1897 he was requested by the Government to examine into the feasibility of the route from the Pacific Coast at Fort Wrangel to Teslin Lake by way of the Stikeen River, and to examine the Teslin Lake and Hootalinqua River to determine its navigability, and further to examine the passes at the head of Lynne Canal, such as the White, the Chilcat and Chilcoot passes. This work was successfully carried out, and his report on this subject has already been referred to in these columns. Last year the Toronto and Hudson Bay Commission created by the City Council of Toronto, selected Mr. Jennings to examine the country from North Bay to James Bay, embracing the Temiscamingue, Temagami, Blanche River, Montreal River and Wahnapitae, which he did during the past summer, obtaining a great amount of information on a comparatively little known region of country, and which information is being laid before the commission for future action with regard to a projected railway to Hudson Bay. Mr. Jennings is a member of the Institution of Civil Engineers of Great Britain, a member of the American Society of Civil Engineers, of the British Association for the Advancement of Science, and of the Imperial Institute. In 1897 he was appointed by Toronto University as examiner in the Department of Civil Engineering under the new system introduced in that year for the conferring of the degree of civil engineer, an honor which may be considered of all the greater value by reason of having been made without his previous knowledge, and by reason of his selection as sole examiner. In 1876 Mr. Jennings married Miss McKay, daughter of the Registrar of the county of Elgin. Mrs. Jennings died in 1887, leaving one son, Gordon T. Jennings, now at the Royal Military College, Kingston, with every prospect of a worthy military career. Mr. Jennings has always had a high conception of the profession of a civil engineer, and his election to the highest honor in the gift of the society is a happy reward for a career marked by faithful adhesion to public and private duty.

GEORGE A. MOUNTAIN.

George A. Mountain was born in Quebec in 1860, and served his apprenticeship in the office of the city engineer of Quebec. In 1878 he served on the engineering staff of Kinniple & Morris, civil engineers, London and Greenock, on the surveys of the Quebec graving dock and the Louise embankments; in 1879 he was assistant engineer on the surveys of the Quebec and Lake St. John Railway; in 1880, assistant engineer on the surveys of the Island Railway, Newfoundland; 1881 to 1886, divisional engineer on the Canada Atlantic Railway, and from 1886 to the present time chief engineer of the Canada Atlantic Railway; 1889, chief engineer of the Coteau bridge across the St. Lawrence River from its inception to its completion; 1891, chief engineer of the St. Lawrence and Adirondack Railway; 1890, to the present time, has been chief engineer of the Ottawa, Arnprior and Parry Sound Railway; and from its commencement also chief engineer of the Parry Sound Colonization Railway from 1892 to 1896. Mr. Mountain became a member of the Canadian Society of Civil Engineers at its organization in 1887. He is a D.L.S., O.L.S.,

P.L.S. At the present time Mr. Mountain is chief engineer in charge of construction and maintenance-of-way on what is known as the Booth system of railways, comprising Canada Atlantic Railway; Ottawa, Arnprior and Parry Sound Railway; Vermont and Province Line Railway; Nipissing and Nosbonsing Railway.

C. E. W. DODWELL, MEM. CAN. SOC. C.E.

C. E. W. Dodwell, B.A., is a son of the late Rev. G. B. Dodwell, M.A. He was born in England in 1853, and in 1862 he came to Canada, beginning his education at Bishop's College school, Lennoxville, and finished at King's College, Windsor, N.S., where he took a full course of engineering and the degree of bachelor of arts, with high honors in mathematics and natural sciences. From 1873 to 1877 he was employed as assistant engineer on the location and construction of the principal lines of railways in Nova Scotia, namely, the Western Counties, the Nova Scotia Central and the Eastern Extension Railways. In 1877 he was appointed assistant provincial engineer under the Government of Nova Scotia. This position he resigned in 1881 to accept an appointment upon the staff of the Canadian Pacific Railway in Montreal. Mr. Dodwell was in the service of this company for about eight years, and during that time was engaged almost exclusively upon construction. The preliminary surveys and estimates for the St. Lawrence bridge were his first work, performed for the company with G. H. Massey, C.E. He was next employed upon the construction of the Ontario and Quebec Railway, first in the position of section engineer, subsequently in charge of the construction office in Toronto. He was next resident engineer in charge of the portion of the C.P.R. from Montreal to Vaudreuil (24 miles), which comprised some heavy work, namely, the large stone viaduct entering the city and the bridges, 33 spans of steel, over the Ottawa River at St. Anne's and Vaudreuil on which latter work he submitted a very clever paper to the Canadian Society of Civil Engineers in 1888. (See Vol. II., part I.) In 1889 he resigned his position on the C.P.R., and in partnership with A. L. Hogg, M.I.C.E., Mem. Can. Soc. C.E., established the firm of Dodwell & Hogg, for a general engineering practice. Occupying his time at this period may be mentioned the waterworks and sewerage systems of Dartmouth, and the waterworks of Amherst, N.S. In 1891 he accepted an appointment under the Federal Government as resident engineer of the Public Works Department, at Halifax, N.S., which position he still occupies. Mr. Dodwell was elected an associate member of the Institution of Civil Engineers in 1881, and he was transferred to the class of members in 1891. He took an active part in the formation of the Canadian Society of Civil Engineers, being one of the original Montreal committee.

FIRES OF THE MONTH.

Jan. 10th. Joyner & Elkington's grist mill, Fort Qu'Appelle, N.W.T., burned; loss is $25,000.——Jan. 11th. Bell & Co.'s tannery, Tilsonburg, Ont.——Jan. 12th. Tara, Ont., public school; loss, $3,000.——Jan. 15th. The charcoal works at Bridgeville, N.S., burned down; loss, $10,000.——Jan. 15th. St. Anne's College, Digby, N.S., loss, $75,000.——Jan. 20th. Roman Catholic church at Rockland, Ont., destroyed.——Jan. 22nd. I.C.R. coal sheds at Moncton, N.B., loss, $1,500.——Jan. 24th. Hercules' Cement Works, Hamilton, Ont.; buildings gutted and stock destroyed.——Jan. 26th. Small fire in Montreal Gas Co.'s works, Montreal, caused damage of $500.

CORRECTIONS.

On page 242 of the January issue of The Canadian Engineer, in the last paragraph of J. M. Williams' article, "Oiling Up," the word "animal" was used instead of "mineral." The sentence should read: " . . . we may be satisfied that in the mineral oils and greases, with their great range of body, their freedom from impairment by atmospheric action and other physical changes, that we may obtain a lubricant fitted especially for our requirements. . . ."

The editorial paragraph in the December issue of The Canadian Engineer did not imply that the Quebec gold areas were the property of the De Lery family, but stated that those of the seignory of Rigaud-Vaudreuil were so held.

REVIEWS.

The Canadian Magazine for February contains some interesting Canadian matter; the portraits of forty editors of Canadian dailies and biographical sketches of each; St. George's Cathedral, Kingston, which was destroyed by fire recently, is the frontispiece; Joanna E. Woods' novel is continued, and the usual complement of short stories and poems finds its place. Unfortunately the series of papers on actors and actresses is kept up. The public will not pay twenty-five cents for a magazine which publishes theatrical portraits. It is distinctly a "marked down" commodity and should be dropped.

Diane of Ville Marie is the title of a new romance of French Canada by Blanche Lucile Macdonell, of Montreal. Miss Macdonell is the author of a number of charming sketches of French-Canadian history and folk-lore, and the present tale, her most ambitious venture, founded on events which took place on the Island of Montreal at the close of the 17th century, shows her to be well versed in early Canadian history. It is well for English-Canadians to know how rich French Canada was in the material of heroes and heroines, for the story is woven around the personalities and lives of actual historical personages, as stated in the preface. The work is handsomely produced from the press of Wm. Briggs, Toronto.

La Quincena Rural.—We have received the first two numbers of this journal published in Buenos Ayres, which is devoted to agriculture and the kindred arts. As its name implies, it will be published twice a month. The subscription price is $20 per year for the capital, and $22 in the country, rates which it is feared will not ensure a large circulation. The rates for advertising are in proportion. One article complains of the want of affection for rural life in the young people of the country preferring to agriculture almost any other occupation, and even "passa los dias en intrigues politias." Sons of the Spanish-American farmers everywhere possessing a territorial patrimony cannot be induced to continue to reside on it, much less to study its proper management. From this practice the agriculture of the country suffers severely. The deserters of the country districts do not appear to despise their properties, but either leave the management of them to a dependent or try to direct the management from the town in which they have taken up their residence. And as the proprietor does not know how to manage the property advantageously each of these plans is equally fated. The small farmers who remain on the land manage much better. The work is done by the family, male and female, and the surplus produce sold. Here in Canada we know as a rule very little about South America. It is obvious from this glance that there is much in the agriculture of that country that is similar to what is found in ours. The editorials in this paper are brightly written and are of a very high class, comparing favorably with the best we have in America.

A NEW GENERAL FORMULA FOR TRAIN RESISTANCE.*

The alchemists of old sought diligently for the philosopher's stone, the inventors of a later age for perpetual motion, and engineers of the nineteenth century have been almost as eager to obtain a general formula which shall reconcile all existing data and experiments upon train resistance. The first two objects of effort are now known to be unattainable, and the third has until now baffled the best minds in the railroad profession. Only a month ago Locomotive Engineering, which for years past has devoted special attention to this subject, said editorially: "We do not believe that it is possible to devise a formula that will show an approximation of the resistance due to different kinds of trains at different speeds when train tons are the basis of calculation."

A general formula which appears to be applicable to passenger trains of all weights, running at all speeds up to the highest limits so far reached, has been lately worked out, however, by John Lundie as a result of a long series of tests of trains in actual service, and is here given to the engineering public for the first time. His methods of obtaining data are decidedly different from, and much more satisfactory than those commonly employed hitherto, where indicator cards of engines drawing trains at constant (?) speed on level (?) track have been made the basis (with an arbitrary allowance for engine friction) of estimates of resistance per ton moved. In order to be of any value such tests must be made in long distance runs, and it is almost impossible to find a hundred miles or more of absolutely level track for the purpose, while it is also difficult to obtain perfectly uniform speed even on a dead level. Mr. Lundie's method of determining train resistance is based on an examination of the speed curves of a train when coasting from any speed to a dead stop. The possibilities of such a method will be instantly evident to an engineer, and it may be said, at once, that the results warrant a decided predisposition in its favor. It is not only possible to obtain the gross resistance due to track and journal friction and air resistance combined, but to differentiate between the air and the friction elements. The frictional resistance of a train being reasonably constant within somewhat wide limits of speed, the speed curve should be a nearly straight descending line from full speed to a point somewhere near a full stop. Now the actual speed curve dips below this straight line, as seen in Fig. 2, clearly showing a decreasing retarding force (due to air resistance), with decreasing speed.

In Fig. 1 are shown in graphic form the results calculated from more than 150 runs made by Mr. Lundie with trains of different weights on the South Side Elevated Railroad of Chicago. It will be seen that these results expressed by the location of points on the diagram, cluster around "straight line curves," and that these lines intercept each other, with surprising accuracy, at a single point located at a definite distance above the origin. This indicates, of course, that the first step in obtaining the final formula has been reached, in the establishment of a constant, representing the minimum possible train resistance for all speeds and weights, and it is interesting to note, by the way, that in none of the recorded experiments so far made on passenger or freight trains of all weights has the resistance per ton been less than the figure indicated by this constant—4 pounds.

Mr. Lundie's formula is as follows:

$$R = 4 + S\left(0.2 + \frac{14}{35 + T}\right)$$

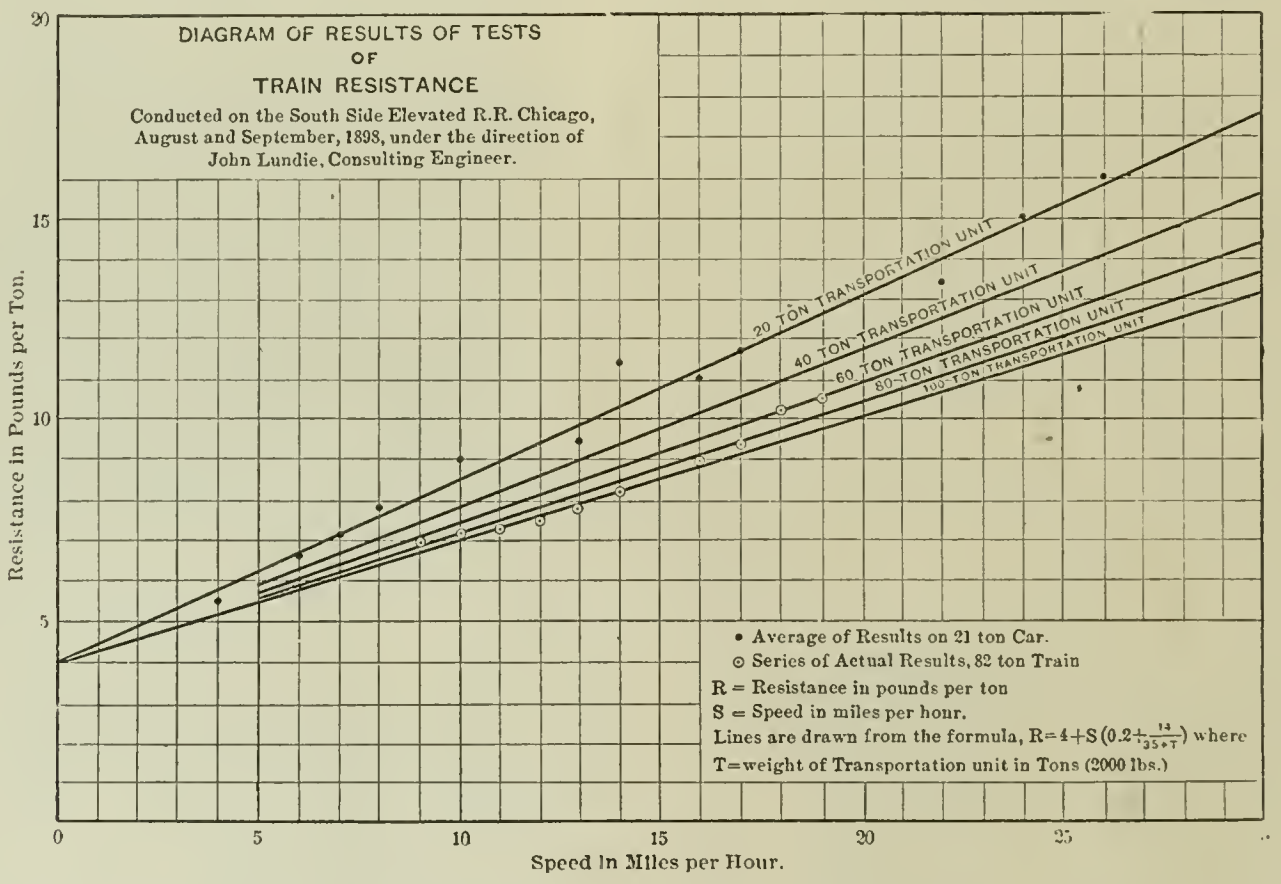
where

T=the weight of the transportation unit in tons (2,000 lbs.)

R=resistance in pounds per ton.

S=speed in miles per hour.

It will be seen at once that unlike most previous formulae, there are here two variables after the constant, namely speed and train weight. Many other investigators have endeavored to accomplish this, but unsuccessfully, and in the formula which has been in most general use in engineering hand-books, that of D. K. Clark, speed only appears as a variable. From a careful



study of his results, Mr. Lundie developed the formula on the following mathematical basis: The expression by which "S" is multipled is proportional to the tangents of the angles made by the lines developed for different weights, as shown in Fig. 1, and is the characteristic of a rectangular hyperbola which (throughout the range of tests made) co-ordinates quite accurately the relations between train weights and the inclinations of the lines mentioned for corresponding weights. The term 0.2 is an intercept on the axis of y; 14 is the constant product of x and y, with the intersection of the asymptotes as origin; and 35 is an intercept on the axis of x.

The test of any formula lies in its application. Gauged by this test, Mr. Lundie's formula unifies in a remarkably close manner nearly all recently published experiments, together with other formulae of more limited application, as will be seen by an inspection of the accompanying table. The Stroudley, Sinclair and Dudley tests of train resistance scheduled in this table were brought together by A. M. Wellington in The Engineering News in 1892, and referred to as intrinsically worthy of confidence on account of the careful manner in which they were made. To these we have added further experiments made on the Philadelphia & Reading Railroad in 1889, and on the Central Railroad of New Jersey in 1892, so that a fairly complete range of train weights from 200 to 400 tons, and of train speeds from 40 to 70 miles per hour is given in the table. The Lundie formula checks up all these tests very closely, though in all but one case the results obtained by its use are slightly

*From the Street Railway Journal, Feb., 1899.

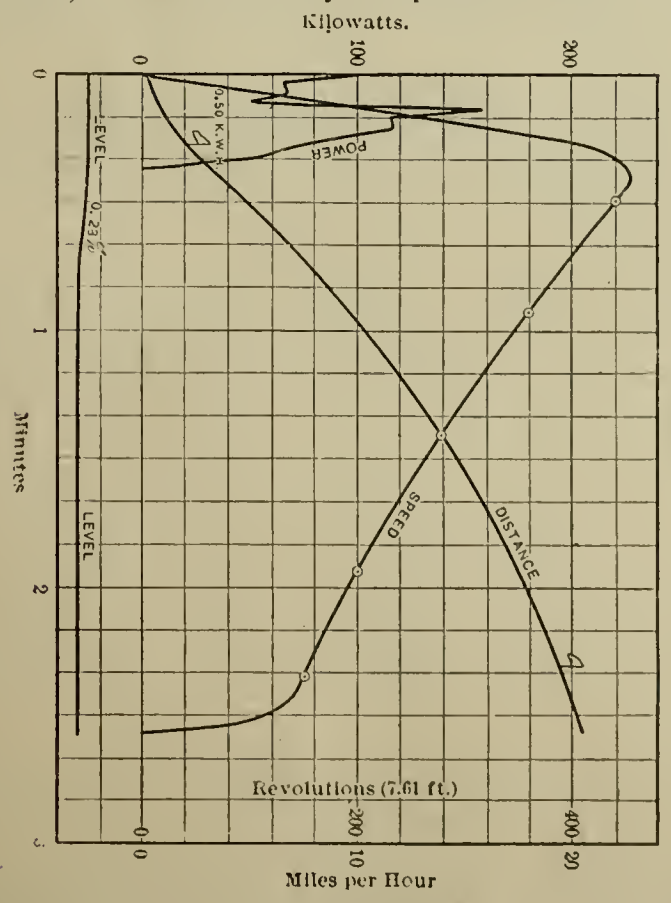
higher than the observed results. In this connection it may be noted that Mr. Lundie obtained his speed figures by positive methods, having found that speed recorders for variable speeds are not sufficiently accurate owing to the inertia of the moving parts.

These tests are all for heavy railroad passenger trains, upon which Mr. Lundie himself has made no experiments. For trains of from 20 to 100 tons, and for speeds of from five to thirty miles per hour, the Lundie formula is accurate, inasmuch as it is obtained directly from 150 or more observations made by Mr. Lundie in Chicago, as before stated. For lighter units still, the formula agrees with the results of private tests made by several of the great electric companies, and checks very well indeed the Clark formula

$$(R = \frac{S^2}{171} + 7.16),$$

bearing in mind that the latter is generally admitted by engineers to be from one to two pounds too high.

Now it need scarcely be pointed out that when a formula of this general kind, deduced on mathematical principles from a large series of experiments within a comparatively narrow range of action, is found to be equally applicable over a much wider range, a strong presumption in favor of the soundness of its underlying principle is established. It seems practically certain, therefore, that the Lundie formula is thus applicable to the whole range of passenger train traction on straight, level, exposed track in a calm atmosphere. It cannot, however, be said to be applicable to street cars running on gritty or dirty rails, and, in fact, it is unfortunately too probable that no formula whatever can be devised for street railway work for which a large factor of safety would not have to be allowed in practice to provide for great differences in condition of track.



An interesting question now arises as to whether the Lundie formula can be made, with some modifications, applicable to all kinds of train transportation, freight as well as passenger. It does not check the most recently obtained data for exceedingly heavy trains. Tests on the Chicago, Burlington & Quincy Railway, made by the old method of engine indicator diagrams, checked by dynamometer car, show that a 940-ton train of loaded freight cars, running at 20 miles an hour, has a resistance on a straight, level track of 5.5 lbs. per ton. By the Lundie formula this would have been 8.3 lbs. per ton. An extremely heavy train of freight cars on the New York Central, weighing 3,428 tons, had an average train resistance, at 20 miles per hour, of about 4 lbs. per ton, or the limiting resistance by the Lundie formula as expressed in the first constant. Other tests on fairly heavy freight train work recently made have shown approximately 6 pounds per ton as an average, when track conditions were good, but these results vary greatly with the condition of the track.

Now it being reasonable to suppose that with the heaviest freight train work the train resistance will approach the minimum, and the New York Central experiment above referred to indicating that this minimum is Mr. Lundie's first constant of 4, it would seem that the latter's first constant within the parenthesis, namely .2, must be inapplicable to very heavy freight-train work, and should be, in fact, modified by a variable.

TABLE SHOWING APPLICATION OF LUNDIE FORMULA TO TRAIN RESISTANCE TESTS.

Test made by	Year.	On.	Mem.	Average Speed. Miles p. h.	Train Weight. Tons.	—Train Resistance— Observed.	Lundie Formula.
William Stroudley..	1885	London, Brighton & South Coast.	Single test	43.3	376	13.2	14.1
Angus Sinclair.....	1892	New York Central	Mean of six tests	70.	270	19.03	21.1
" "	1892	" "	Single test	69.6	270	19.8	21.2
P. H. Dudley.....	1882	" "	Single test	51.43	313	16.9	16.35
" "	1889	Philadelphia and Reading	Single test	60.	242.5	18.35	19.0
" "	1889	" " "	Single test	63.5	242.5	19.8	19.9
" "	1892	C. R. R. N. J.	Single test	63.2	213	19.0	20.2
Clark formula.....	....	.....	.....	10	100	7.74	7.04
" "	....	.....	.....	10	200	7.74	6.6
" "	....	.....	.....	10	300	7.74	6.4
" "	....	.....	.....	20	100	9.5	10.06
" "	....	.....	.....	20	200	9.5	9.2
" "	....	.....	.....	20	300	9.5	8.8
" "	....	.....	.....	30	100	12.42	13.1
" "	....	.....	.....	30	200	12.42	11.8
" "	....	.....	.....	30	300	12.42	11.3

probably T. It would be interesting, therefore, to bring together and plot in diagrammatic form, reliable results of a large number of freight-train tests taken with different weights and speeds, to see if a modification of the Lundie formula cannot be made for general application to the heavy class of work as well as light, and we are inclined to believe that were this experimenting once done there might quite possibly be found a common ground of reconciliation between the two grades of service, by which a formula possessing the general characteristics developed by Mr. Lundie could be made applicable to the entire range of railroad transportation. We believe this formula to be so valuable a part of the technical equipment of a railroad engineer, that we earnestly hope it will excite the widest possible comment and criticism in the engineering press to the end of bringing out all the evidence bearing upon its reliability.

ACCIDENTS.

E. Donald, an employee of the Record Foundry and Machine Co., Moncton, N.B., was caught while oiling some shafting about 15 feet above the floor a short time ago. His clothing was completely stripped off and he escaped without other injury than a few bruises, and a severe nervous shock.

Chas. H. Martin, some years ago of Martin & Son, iron founders, Belleville, Ont., was killed by the bursting of an emery wheel in Chicago, a short time ago.

Cornelius McGourty, contractor, St. John, N.B., was killed, January 6th, by a dynamite explosion near the Mispec pulp mills. A bag containing dynamite caught fire and Mr. McGourty tried to carry it to the stream close by, but the explosion came before he reached it, and he was blown to pieces, the workmen.

whom he had called on to save themselves when the fire was first noticed, all making their escape.

William Tossel, employed at the Imperial Oil Co.'s works, Petrolia, Ont., had occasion to go on top of the stills recently, and by some means he fell to the ground and was killed.

Arthur Dunnett, employed by the Brantford, Ont., Starch Co., came in contact with a belt and received serious injuries before he could be rescued.

J. McTavish, North Bay, Ont., a C.P.R. brakeman, was run over by his train at Eau Claire, Jan. 21st, and received injuries from which he very shortly afterwards died.

By the explosion of the boiler in the ice house of the Knickerbocker Ice Co., Toronto, A. Evoy was killed. The jury found that the neglect of the engineer had been the cause of his own death.

Industrial Notes.

Hamilton, Ont., will begin its new $30,000 sewer on Birge avenue this year.

The capital stock of the Gurney Foundry Co., Ltd., has been increased from $350,000 to $750,000.

The Canadian Rubber Co., Montreal, has ordered a 30 h.p. engine from the Robb Engineering Co., Amherst, N.S.

During 1898 the Galt, Ont., waterworks pumped 236,999,944 gallons and the gross revenue was $12,381.94

The Diamond Glass Co., Ltd., is applying to Parliament for leave to enlarge its capital from $500,000 to $1,000,000.

The Perth, Ont., Public School will be enlarged at a cost of $5,050. Geo. Bradford, Almonte, Ont., has the contract.

It is announced that the Manufacturers' Life Insurance Company will erect a $35,000 building at Brantford, Ont.

The laborers in the Frost & Wood works, Smith's Falls, had a 10 per cent advance in wages given them January 1st.

A by-law guaranteeing the interest on $15,000 bonds of the Chatham Cold Storage Company was defeated at Chatham recently.

H. J. Powell's plans have been accepted for the Melville Presbyterian church at Fergus, Ont., to be built at a cost of about $15,000.

Messrs. Knight Bros., Burks Falls, Ont., have ordered a 60 h.p. automatic engine from the Robb Engineering Co., Amherst, N.S.

The Bras d'Or Gazette states that surveys are to be made at Glace Bay as well as Louisburg for a site for the proposed smelting works.

There are three suits for damages pending against the City of London in connection with the City Hall catastrophe that took place a year ago.

The Hamilton and Toronto Sewer Pipe Company will build a three-story structure, costing $11,400, to replace the burned buildings in Hamilton, Ont.

A Vancouver firm has been awarded the contract for supplying that city with four miles of 22-inch double riveted steel water pipe and fittings at a cost of $40,000.

The Thousand Island Carriage Company, Gananoque, Ont., has gone into liquidation, with J. T. Green as liquidator. The works have not been running since Christmas.

Campbelltown, N.B., has an arbitrators' bill of $8,000 and almost as much more for legal expenses to pay before it can take up the award in the recent waterworks arbitration.

C. A. Matheson, Perth, Ont, who owns some swamp land near the town, has bought a 15-ton peat plant, and the patent right to manufacture peat fuel in the county of Lanark.

Letters patent have been issued incorporating R. Gray, J. S. Gray, M. Daniels, J. A. McKeon, M. Campbell, Chatham, Ont., as the William Gray & Sons Co., Ltd. to manufacture carriages and other vehicles and also bicycles in Chatham, Ont., with a capital of $150,000.

Kincardine, Ont., will make a loan of $4,000 to Hunter Bros., manufacturers of boilers, etc.

An explosion wrecked one of the buildings of the Stratford, Ont., gas works recently. Damages were about $2,000.

Jas. Fleming, St. John, N.B., has supplied the boilers for W. H. Fowler's new flour mill, Rodney wharf, St. John.

A citizens' committee has been appointed in Guelph, Ont., to forward the installation of a system of sewage disposal.

Robert Bell, iron founder and machinist, Seaforth, Ont., will receive a loan of $17,000 from the town to extend his business.

Woodstock, Ont., Board of Trade proposes to raise by taxation $25,000 "to be given to new industries which may locate in Woodstock."

The Macdonald Mnfg. Co., Toronto, whose premises were burned some time ago, is about to build a $32,000 factory to accommodate 125 hands.

The employees of the Ontario Rolling Mills, Hamilton, held a ball January 21st at Grimsby, Ont., going down on a special on the H.G. & B. electric railway.

Seaforth, Ont., asks leave of the Ontario Legislature to make a loan without interest to T. R. F. Case & Co. of $20,000, to enable them to establish a pork-packing industry in the town.

In one week, not long ago, a Waterloo furniture manufacturer shipped a car-load of office desks to Liverpool and took an order for the furnishing of a church in Cape Town, South Africa.

The Montreal Water Commissioners have decided to secure an engine temporarily for the high level pumping station until the new boilers which are considered necessary can be supplied.

The Quebec Bridge Company have held a meeting, under the presidency of Mayor Parent, and decided to award the contract on March 1st, and go on with the work as far as their finances will allow.

The property owners of Oshawa, Ont., voted on Jan. 21st on a by-law to raise $110,000 by issuing debentures for a waterworks and sewerage system, resulting in the by-law being carried by a majority of 67.

An explosion of acetylene gas recently in the general store of the A. B. Scott Co., Millbrook, Ont., caused, it is said, by recharging the generator while in use, partially wrecked the building but only slightly injured the employees.

Robert Arnott has rebuilt his cheese-box factory at Peterboro, Ont., which was damaged by fire last June. The new factory is equipped with all the newest and most modern machinery. It has a capacity of 100,000 boxes per season.

An experiment of interest to people in the Ottawa Valley is to be tried at Trenton, Ont. A number of mechanics in that town have formed a co-operative lumber cutting and furniture manufacturing company, with a capital stock of $30,000. They expect to employ 75 men and the business will be managed by seven mechanics.

Application will be made at the next session of Parliament to amend the charter of the Alberta Irrigation Company by changing the name of the company to the Canadian Northwest Irrigation Company; changing the place of head office to London, England; authorizing directors to vote by proxy; increasing capital to $1,000,000.

The $20,000 necessary to establish the building and plant for the proposed pork packing industry at Middleton, N.S., has been subscribed, but as almost as much would be necessary to carry on the business the project will not be gone on with for some months, though the capital will undoubtedly be soon subscribed. E. D. Davison, Bridgewater, N.S., is president of the company.

The Commissioner of Crown Lands for Ontario has offered a prize of $10, to be competed for by the students of the School of Practical Science, Toronto, in some subject relating to forestry, to be named by the principal. The announcement was made by Thomas Southworth, chief of the Forestry Department of Ontario, to the Engineering Society of the School of Practical Science, which he addressed on the subject of Engineering as Related to Forestry in Ontario.

It is learned that the Dominion estimates for the ensuing year will contain votes for the erection of a new building for the Geological Survey and Museum, and also one for the records and archives.

The following officers of the Toronto Board of Trade have been elected by acclamation: President—A. E. Kemp; first vice-president—A. E. Ames; second vice-president—W. E. H. Massey; treasurer—J. L. Spink.

T. T. W. Bready, J. Love and C. R. Tryon, Winnipeg, Man., and J. Carruthers and C. W. Band, Toronto, are applying for a Dominion charter as the Winnipeg Elevator Company, Ltd., with a capital of $300,000.

W. P. McMicking, D. J. Bastien, W. H. Spillman, E. E. Adams, J. McC. Field, W. Smith, J. S. Greenhill, Leamington, Ont., and W. E. Lee, Virgil, Ont., have been incorporated as the Leamington Veneer and Basket Co., Ltd.; capital, $3,000.

A. W. Campbell, Provincial Road Instructor, recently went to Cornwall, Ont., to consult with the Town Council there regarding the disposition of $20,000, which has been voted by the ratepayers for the purchase of machinery and the construction of a number of new roads.

C. Cannom, G. N. Weeks, L. Nichols, J. H. Dunn, R. A. Little, and G. F. Morris, London, and J. E. McGuffin, Township of London, have been incorporated as the Cannom Stove and Oven Company, Ltd., with a capital of $20,000, to do business as manufacturers of stoves etc., in London, Ont.

W. Sproule and S. W. Trusler, Plympton, Lambton county, Ont.; G. Knight, T. Carrick, Sarnia, and R. E. Moss, M.D., Port Huron, Mich., have been incorporated as the Lambton Oil Co., Ltd., to deal in and refine oil, etc.; capital, $20,000; chief place of business Sarnia, Ont.

The advertisement of the wire rope output of the B. Greening Wire Co., Hamilton, reminds us of the fact that that old and firmly established firm is now being managed by the third generation of its founder's family, as is pleasantly told by the portraits of the three members of the Greening family on the calendar issued by the firm.

It is reported that the total sales of lumber in Manitoba and the Northwest this year exceed those of last year by about 30,000,000 feet. The quantity of spruce cut in Manitoba mills is estimated at 15,000,000 feet in excess of last year. The growth of the trade in imported lumber from the United States has been very great. In 1892, before the duty was taken off, the importation of rough lumber was only a little over a million feet, while that of dressed lumber was very much smaller. In 1897 the importation from the States amounted to 16,000,000, and in 1898, 35,000,000 feet. This is of course, chiefly undressed lumber. The quantity of pine from the Rat Portage mills is estimated at over 50,000,000 feet.

W. M. Watson, Toronto, has designed and completed a model of a square built hot air furnace. The height is 5½ feet by 3 feet by 3 feet square. The fire pot is circular, measuring 22 inches across, and is 12 inches deep. The cold air enters at the floor line, and is conducted by bent channels upward in thin streams over the radiating plates in a way that causes a very rapid current and great heating power. The advantage of this method of heating air is, the inventor claims, that about 75 per cent. more cold air can be heated to a given temperature with the same weight of coal as is used by the present hot air furnaces, because it contains over 150 square feet of direct heating surface plates that are self cleansing and cannot become coated by soot or dust. This furnace can, it is stated, be manufactured quite as cheaply and would be as durable as any other furnace.

The Fairbanks Co., which for many years has had an agency in Montreal for its well-known scales, has opened a warehouse of its own. The Fairbanks Co. controls besides its scales, the output of a number of factories, and at the show rooms their products are on exhibition. The asbestos disc valve of this company, for which an advertisement is inserted on another page, is an article of the highest grade. Asbestos seat gate valves, asbestos packed cocks, and Vulcabeston packings complete this line. Trucks of all kinds are in evidence. Norton emery wheels and Nicholson files are also carried. In the basement is a 6 h.p. gas engine of the Fairbanks' Company's own make, used to work the lift and furnish power for the repair shop. The Fairbanks Co. has just issued a 240 page catalogue of supplies, which they will gladly send on request.

Electric Flashes.

Hanson Bros. syndicate of Montreal has taken possession of the Havana street railway.

At Ottawa the Sunday car vote resulted in an overwhelming majority for the cars. The figures are: For, 4,628; against, 1,664; majority for, 2,964.

A vote was taken January 9th in Bradford, Ont., on a by-law to raise $6,000 for the purpose of putting in an electric light plant. The by-law was defeated.

The Department of Railways and Canals has placed an order with the Canadian General Electric Co. for additional apparatus to be used at the Sault Ste. Marie Canal.

The Bell Telephone Company has decided to place more of its wires under ground in Hamilton, Ont., as there has been very great loss occasioned by sleet storms on more than one occasion.

The Hawthorn Woolen Mill Co., of Carleton Place, Ont., is increasing its lighting plant and has placed an order with the Royal Electric Co. for a 25-k.w. bipolar generator, which is to be installed at once.

The Canadian General Electric Co. is installing for H. A. Lozier & Co., Toronto Junction, Ont., one of their 200-light dynamos, with marble panel, and wiring up some 200 incandescent lights, in their new factory.

The Watson Mnfg. Co., St. Catharines, Ont., is removing to its new factory at Paris, Ont., and has placed an order with the Canadian General Electric Co. for the wiring up of the factory, and installing a plant to furnish some 250-16 c.p. lamps.

Incorporation is sought for a company under the name of the British Columbia Telephones, Ltd., to acquire the New Westminster, B.C., and Burrard Inlet Telephone Company, Ltd., and the Vernon and Nelson, B.C., Telephone Company.

The Central Construction Co., 263 Main street, Buffalo, N.Y., whose specialty is water, steam and electric power plant construction, has the contract for the Orillia, Ont., electric power plant at $75,000, for which the ratepayers voted the necessary funds on February 6th.

At the electric railway car shops, Niagara Falls, Ont., eight men are employed in the building of six large new open cars for the use of the road during the summer, and one of the cars is now completed. It is a double truck, 35 feet long, with a seating capacity of 75 people.

Incorporation is asked for the Hamilton and Caledonia Ry. Co. to construct a railway from Hamilton, Ont., to Caledonia and Cayuga, and extend it to Selkirk, a point on the shore of Lake Erie. The line may be operated by steam or electricity, and will also deal in natural gas.

N. P. Tanquay, Esq., of Weedon, Quebec, has contracted with the Canadian General Electric Co. for a standard 55-k.w. new type multi-polar generator, and a 35-h.p. motor, together with marble panels and all line material and supplies required for carrying out the transmission of the above power.

The works of the Chambly Mnfg. Co., have been somewhat damaged owing to ice breaking the apron of the dam. A new timber apron has been constructed, five feet thick, and no further trouble is believed to be possible. The installation is expected to be entirely complete, and the current turned on about May 1st.

The Bruce Mines and Algoma Railway Company asks for an Ontario charter to construct a railway from Bruce Mines, Ont., northerly to the Rock Lake Copper Mines, thence northerly a distance of thirty miles, with power to equip by steam or electricity, and if the latter, with power to sell the surplus electric energy for light, heat and power purposes, and to supply the miners with electricity for their mines, and also to construct branch lines of railways not exceeding twelve miles in length.

The Canadian General Electric Co. has just received another order from the Montreal Ry. Co., for 12 standard G.E. 1,000 railway motors.

The Stanstead Electric Light Co., Stanstead, Que., has recently purchased a 2,000-light single-phase alternator from the Canadian General Electric Co.

The Canadian General Electric Company has closed a contract with A. S. & W. H. Masterman, Montreal, for a new type multi-polar 200 light generator.

A. Gagnon & Co., Arthabaskaville, Que., have recently installed a new 2,000-light single-phase alternator of the Canadian General Electric Co.'s new type.

The Ottawa Electric Co., Ottawa, has recently added to its arc lighting equipment, one No. 12 125-light Brush arc dynamo, purchased from the Canadian General Electric Co.

The Hamilton, Ont., Street Railway Co. paid the city for mileage and percentages on gross receipts for the last quarter of 1898, $3,602.21. For the same quarter in 1897 the amount was $4,163.49.

The Guelph Light & Power Co. has recently purchased a new 1,000 light single-phase alternator from the Canadian General Electric Co., together with marble switchboard panels for the control of two machines.

The R. & O. Navigation Co. has placed an order with the Canadian General Electric Co. for a standard 30-k.w. direct-current generator, to be direct connected to an "Ideal" engine, manufactured by the Goldie & McCulloch Co., of Galt.

The town of Essex, Ont., is to have an incandescent system of electric lighting. C. E. Naylor, of that place, having undertaken the operation of the system, has purchased from the Canadian General Electric Co., a 750-light machine for the purpose.

The Canadian General Electric Co. has recently installed for Robertson, Rowland & Co., Walkerton, Ont., a 2,000-light single-phase alternator. This company has been operating a 60-k.w. machine, of a similar type, for the past four years, and has met with great success in the electrical lighting.

The corporation of the town of Bothwell, Ont., has awarded a contract to the Canadian General Electric Co., for a 500-light plant, to be used for commercial and street lighting purposes. The lighting of the streets will be done by 15 enclosed arc lamps, of the latest type, which will be operated from the same machine.

The E. T. Wright Company, Hamilton, Ont., is having installed in its factory a 50-h.p. S.K.C. motor to drive the factories. The power by which this motor is driven is taken from the Cataract Power Company's wires. This is the 10th installation from this company's service into factories in Hamilton up to date.

The Montreal Water & Power Company of Montreal is installing in its pumping station a 400 h.p. S.K.C. two-phase motor operating at 180 r.p.m. This motor is intended to operate the waterworks pumps, and will be driven by current generated at Chambly rapids, a distance of sixteen miles away. This is one of the largest single motor installations in Canada.

The Royal Electric Co. has received an additional order from the Hamilton Electric Light & Power Company for a 500 h.p. S.K.C. two-phase synchronous motor, which is to operate a shaft driving their arc circuits and street railway power circuits. This is an addition to the two 350-h.p. motors noted in these columns recently.

Corley & Collins, Mount Forest, Ont., have experienced such an increased demand for lighting during the past two months that they were compelled to increase their facilities, and have purchased from the Canadian General Electric Co., a standard 1,000 light single-phase alternator, with marble panel switchboard and exciter, to meet these requirements.

There is an application to the Dominion Parliament for a charter for an electric railway from Ottawa, through the township of Nepean, Ont., by Kingsmere to Meach's Lake, in the District of Ottawa, in Quebec; also to construct to Hog's Back and Graham's Bay, in Nepean, and the town of Aylmer and city of Hull, Que.; also to construct a railway, foot passenger and vehicular bridge across the Ottawa River from Nepean to Hull at the Remous Rapids, in the township of Nepean.

R. G. Code, A. F. May, A. Macfarlane, E. F. Burritt, C. T. Moffat, Ottawa, Ont., will be incorporated as the Royal Telegraph Co., Ltd., to build, buy or operate telegraph and telephone lines in any part of Canada. The capital is to be $100,000, and the chief place of business, Ontario.

A trust for electric carbons has been formed in Chicago under the name of the National Carbon Company with a capital of ten millions, and taking in the twelve largest carbon factories on the continent. One of these was said to be the Ottawa Carbon Works, which controls the business in Canada.

E. S. Jenison has completed his surveys for the power canal from Kakabeka Falls to Port Arthur. The reservoir will be on the highlands west of Port Arthur and will cover an area of four thousand acres, with a depth of from fifty to seventy-five feet. Its surface will be three hundred and three feet above Lake Superior.

The London Electric Co., has placed an order with the Canadian General Electric Co. for another No. 12 4-circuit 125-light Brush arc dynamo, and an additional 300-k.w. revolving field single-phase alternator. When these are installed this company will have one of the most complete lighting stations in Canada.

The steamer "Pro Patria," of Halifax, N.S., is being equipped electrically, and for the purpose of lighting the steamer and operating searchlights, an order has been placed with the Canadian General Electric Co. for the complete outfit, which will consist of a standard C.G.E. direct connected equipment, including engine, dynamo, switchboard, searchlight and wiring complete.

Jas. Madden, jr., formerly of Welland, Ont., who recently graduated from the Peterboro works of the Canadian General Electrical works, has been appointed to a position with the Lachine Rapids Hydraulic and Land Company of Montreal, where he has been temporarily located since graduation. His duties are the charge of the switch board of the company and the supervision of the repairs in the company's electrical lines.

The Canadian General Electric Co. has been awarded, by the Department of Railways and Canals, the contract for the erection of a power house, and the complete equipment of the Soulanges canal with electrical apparatus, for operating the locks by means of electric motors. The entire canal, covering a distance of 14 miles, will be illuminated by arc lamps. Owing to the success met with by the Department in the operation of electricity of the canal at Sault Ste. Marie, Ont., as applied to the locks, it has decided to make a more extensive application of the use of electricity, in the illumination and electrical operation of the locks of the Soulanges canal.

The Queen Victoria Niagara Falls Park Commissioners met in Toronto on the 4th inst. to consider amended plans of the proposed works on the Canadian side, which the Niagara Falls Power Company has submitted for their approval. These plans involve the removal of the power-house from just under the bluff, at a point about 200 yards from the street railway power-house, to a site much nearer the river, and close to Cedar Island. This will greatly shorten the intake leading to the power buildings, but will necessitate a much longer tunnel, to a point below the Falls, for the purpose of conveying off the waste water. The commissioners will carefully consider the changes in order to see that the plans do not deface the park and the scenery to a greater extent than those approved of four years ago.

The Canadian General Electric Co. has recently sold to Evans & Hastings, printers, Vancouver, B.C., a 6 k.w. Edison dynamo; to Braid & Co., of Vancouver, B.C., a 10-h.p. motor for use in their spice mills; a 50-light dynamo to be installed in the premises of a customer at Edmonton, N.W.T.; to the Savoy Theatre at Vancouver, B.C., a 250-light incandescent lighting dynamo, of the multipolar slow speed type; to McKenzie Bros., of Victoria, B.C., a 6-k.w. Edison motor; to the British Columbia Electric Railways Co., to be used in driving the blower apparatus in the power house, a 12-k.w. Edison motor; to Hoffmeister Bros., Vancouver, B.C., a 25-light incandescent lighting dynamo; to J. C. Woodrow, Vancouver, B.C., a 3-k.w. Edison motor, and to Hinton & Co., Vancouver, B.C., to be installed on a steamer navigating Lake Bennett, a 25-light incandescent dynamo.

Peterborough is asking the Ontario Legislature for leave to develop water power on the Otonabee River, and supply electric light, heat and power.

Sir William Meredith, B. B. Osler, Q.C., and F. P. Sargent have completed their arbitration in the Grand Trunk telegraphers dispute, and have made an award fixing a time and wage schedule, and providing for over time pay, etc.

Dr. Arthur E. Kennelly, the president of the American Institute of Electrical Engineers, has come to Montreal to deliver a series of four lectures at McGill University. A popular lecture on Submarine Telegraphy was given in the Physics building, McGill, January 30th.

John Philip, Grand Valley, Ont., is supplying the town of Grand Valley and the town of Arthur, Ont., which is thirteen miles away, with incandescent light from his incandescent lighting plant in Grand Valley. He has had such success with transmission plant from Grand Valley to Arthur that he has purchased from the Royal Electric Company a 75-k.w. S.K.C. two-phase alternator, which he is installing in his power station. This will enable him to deliver at least 1,000 lights, wired up, in Arthur, and also to serve everything in Grand Valley. As heretofore noted this is a new departure in lighting, as the power-house depends for fuel upon the refuse from a sawmill, which before the present plant was installed was a nuisance, but is now a valued source of income.

Railway Matters.

Trains are now running from Skagway to Log Cabin over the White Pass Railway.

The C.P.R. car shops at Perth, Ont., are turning out this winter 300 box cars, 60 coal cars and 50 flat cars.

The Lake Erie & Detroit River Railway has decided to erect a new swing bridge over the Thames river at Chatham, Ont.

The preferred stock, $1,000,000, of the Kingston and Pembroke Company, authorized by the Government, has all been subscribed.

Application will be made for the right to build a line of railway from Edmonton to Victoria, and Beaver Lake to South Edmonton, N.W.T.

The Gatineau Valley Railway will be extended this year from Gracefield, the present terminus, to Maniwaki, a distance of twenty-eight miles.

Hereafter the Lake Manitoba Railway and Canal Company will be known as the Canada Northern Railway and a charter secured authorizing the building of a line from Lake Winnipegosis or thereabouts to Edmonton or thereabouts.

George Appleby of Darling's Island, Kings county, N.B., is doing the work on his contract in connection with the I.C.R. improvements of removing the St. John Bridge and railway extension track to such a point as may be deemed advisable.

Application will be made for a charter for a railway from Edmonton, N.W.T., thence via Athabasca Landing and Lesser Slave Lake to Peace River; also to permit the railway company to own vessels and navigate the Athabasca River from Athabasca Landing to the mouth of Little Slave River and up the same into and through Lesser Slave Lake.

The Lake Erie & Detroit River Railway Company has taken over on lease from the United States & Ontario Steamship Navigation Company the car ferry "Shenango No. 1" and the slip docks at Port Dover, Ont., and Conneaut, Ohio, for a term of five years. This means that the Lake Erie & Detroit River Railway Company have secured control of the ferry business on Lake Erie.

R. Patterson has been appointed master mechanic of the Grand Trunk shops at Stratford, vice J. D. Barnett resigned. He was formerly locomotive foreman in that section, and was for some time previous connected with the erecting shops. He was removed from Montreal to Toronto some years ago, and upon the advent of the new management was removed to Fort Gratiot, Mich., as master mechanic of the Chicago and Grand Trunk, succeeding William Roberts.

S. F. Barker, Hamilton, Ont., has been elected president of the St. Louis, Kansas and Southwestern Railway, and J. N. Young, who was the original promoter of the Toronto-Hamilton and Buffalo Railway, has been elected vice-president and manager. Three months ago, Mr. Barker representing Canadian holders of bonds to the value of $800,000, bought the road at auction for $150,000.

The Toronto, Lindsay and Pembroke Railway Company is applying for incorporation to construct a railway from Golden Lake, Ont., to a point on the Irondale, Bancroft and Ottawa Railway, or the Central Ontario Railway, in the county of Hastings, there to connect with the Irondale, Bancroft and Ottawa Railway, or the Central Ontario Railway, or any other railway. To be operated with steam or electricity.

At the present session of the Ontario Legislature application will be made for an Act to incorporate the North Lanark Railway Co., with power to build a line from the Kingston & Pembroke Railway, near Mile Lake, in Renfrew county, to the C.P.R. or O.,A. & P.S. Railway at Arnprior. The route of the proposed road has been surveyed by A. Bell, C.E., of Almonte, acting for a number of capitalists interested in iron mining.

The Canadian Pacific Railway Company intends making application at the forthcoming session of Parliament, says The Vancouver World, for a charter to build a line of railroad from a point at or near Cranbrook or Fort Steele, B.C., on the line of the Crow's Nest Pass Railway, northerly along the Kootenay and Columbia Rivers, to a point at or near Golden, with power to operate branch lines of railway extending from the proposed new line a distance of not more than 30 miles.

It is proposed to build a railway from the outlet of Kamloops Lake; thence by the most direct and feasible route to the plateau of the Bonaparte River; thence to a point on the Cariboo wagon road near the One Hundred-Mile House; thence following generally the route of the Cariboo wagon road to the mouth of Quesnelle River; thence northwesterly, following generally the route of the Telegraph Trail to Hazelton, at the Forks of the Skeena River; and thence north and northwest by the most convenient and feasible route to a point in the vicinity of Atlin Lake; with power to build a branch line to Teslin Lake.

D. C. Fraser, M.P., for Guysboro, N.S., who introduced the British Yukon Railway Bill into Parliament, and who has since visited the scene of the company's operations, says that after completing the track from Skagway to Lake Bennett, 37 miles, they will build 100 miles of road into the Atlin country, joining the Hootalinqua River, and thus securing good navigation to Dawson City. He further says that the line is practically located all the way to Selkirk and that if Canada wishes for it, there is nothing to prevent her from securing the whole of the Yukon trade.

Application is being made for a charter for the Worthington & Onaping Railway Company, with power to construct, lay out, and build a railway from a point at or near Worthington Station, in the township of Drury, Algoma; thence northerly near the Inez mine in the said township, thence northeasterly to the Sultana nickel mine in the township of Trill, thence northerly and easterly a distance of about fifty miles, crossing the main line of the Canada Pacific Railway at or near Onaping Station, and with power to equip and operate the same by steam or electricity.

Vancouver, Northern & Yukon Railway Company is applying for a British Columbia charter to construct a railway from some point at Vancouver, or other point on the shore of Burrard Inlet, thence running in a northerly direction by way of Seymour Creek, to the Squamish Valley; thence through the Pemberton Meadows to Lillooet; thence northerly to Quesnelle; thence northwesterly to Hazelton, or some other point on the Skeena River; and thence northerly to the northern boundary of the province; with power to build a branch line from Hazelton along the valley of the Black River to the northern boundary of the province; with power to build branch lines to Fort St. John; with power also to build branch lines east and west from the main line along the north shore of Burrard Inlet to Howe Sound and the west shore of the North Arm of Burrard Inlet; with power also to build and operate branch lines from time to time to groups of mines and to farming lands from any point on the main line or any of its branches; and to use steam or electricity.

The C.P.R. is to spend $500,000 on its Detroit-Megantic section this season in improvements.

Application will be made for the revival of the charter of the Lindsay, Bobcaygeon and Pontypool Railway Co.

An action has been taken in Toronto by the Alberta Coal & Railway Company against Mackenzie & Mann, the late Yukon railway contractors, the plaintiffs claiming from that firm the sum of $100,000, alleged to be due for rails and rolling stock.

The Algoma Central Railway will apply for an Ontario charter at the next session of the Legislature; the proposed line will run from Sault Ste. Marie, Ont., to the Michipicoten River, thence northerly to the C.P.R., and southerly to Michipicoten harbor on Lake Superior.

Application will be made for the right to build a line of railway from Chute Aux Iroquois, in the county of Labelle, Que., to a point near Lake Nominingue, in the county, and thence to a point near Lake Temiscamingue, and to operate lines of telephone and telegraph alongside the same.

The Kootenay Valley & Burlington Railroad is being built by Foley Bros., Larson & Stevens. The entire distance to be built is 50 miles, and the contract provides for its construction by July 1, 1899. It will require the employment of 5,000 men to complete the work, which will be rapidly prosecuted.

The Deseronto car works are turning out a large order of box cars for the Intercolonial Railway. Each car is of 60,000 lbs. capacity, and will be built of the very best material. The cars will be fitted with Sterlingworth brake beams, Westinghouse air-brakes, automatic couplers, steel trucks, Chicago roofing patent grained doors, etc.

In the financial year just past the Quebec Government gave to the Quebec, Montmorency & Charlebois Railway, $15,191.15; to the East Richelieu Valley Railway, $5,000, and to the Great Northern, $120,093.97. The Government announces that no bonuses will be paid to railways this year, and all the promises of the late Government are repudiated.

Thirty-two years ago Nova Scotia granted the Windsor & Annapolis Railway Company a drawback of duties on materials and stock used for the construction and operating of the road. Parliament in 1896 authorized the extinguishment of the right, and $100,000 has been paid to the Dominion Atlantic Railway Company, successors of the original incorporators, in commutation of it under an agreement signed October 7. The last Gazette contains a proclamation repealing the legislation granting the concession.

Application is being made for an Ontario charter for the Thunder Bay, Nepigon and St. Joe Railway. The route proposed is from Port Arthur via Dog Lake and Black Sturgeon Lake to Black Sturgeon Bay on Lake Nepigon, a distance of 68 miles. A surveying party has returned to Port Arthur after making a preliminary survey. They report finding good country throughout the distance, free from difficulties in construction. The country is level, well wooded with pine, tamarac, spruce, cedar and birch. Fully one-third of the country is occupied by small lakes simply teeming with fish, and there are several million acres of good agricultural land near the upper part of the line. Deposits of limestone and marble, useful for fluxing purposes, iron ore, salt and lignite are said to have been found in the district.

Mining Matters.

The Dominion Coal Co. has closed down the mining works at Bridgeport, Cape Breton.

A Wabigoon, Ont., correspondent gives news of the existence of a large vein of hematite iron ore to the north of Wabigoon.

The Canadian General Electric Co. has recently sold to the Comstock Concentrator, Silverton, B.C., a 25-light Edison dynamo.

J. H. Fraser, Petrolia, driller, has given up for the season prospecting for the Standard Oil Co. in Manitoulin. The exploration will be resumed in the spring.

Hastings county, Ont., felspar is now in demand in England for glazing purposes, and users state that it is much superior to the Scandinavian product now almost exclusively used.

The Canadian General Electric Co. has recently sold to the Athabasca Gold Mining Co., Nelson, B.C., a 100-light Edison dynamo, to be used in lighting the work buildings at the mines.

The Canadian General Electric Company has recently sold to the Scottish Colonial Mining & Milling Co., of Three Forks, B.C., a 100-light 16-c.p. incandescent dynamo, to be used in lighting buildings at the mine.

Work on the Zenith zinc mine to the east of Fort William, Ont., near Rossport, owned by H. J. Beemer, of Montreal, is being pushed. Warehouses have been put up, stables built and the Canadian Pacific Railway have arranged to run a spur track twelve miles out to it.

The Wm. Hamilton Mnfg. Co., Peterborough, Ont., has received the contract for the erection of a 10-stamp mill on the Bend 'Or property in the Bridge River district, B.C. There is ample water power and the company has agreed to have everything in running order by July 1st, 1899.

Sultana Island, upon which is situated the celebrated Caldwell gold mine, has an area of about 500 acres. The Caldwell property comprises 47 acres. The ownership of the balance of the island, known as the Ophir property, has been in dispute since 1889. The Commissioner of Crown Lands has recently given final judgment in the case, and decided that the Ontario Mining Company is entitled to an undivided third of the claim; Margaret Johnston and associates to an undivided third, and the Canadian Pacific Mining and Prospecting Company and the Seybold Syndicate to the remaining third.

There is to be a new graphite company at Grenville, Que., which will be capitalized at $500,000 and is composed of Pennsylvanians. The application for incorporation is now being made. The property at Grenville was worked in 1860, but since then has not been touched. The graphite is said to be 98 per cent. pure and the deposit large. It is the intention of the company to operate at St. Malachi also, where a fine property has been secured. The company will, it is said, erect mills at both places, but at present the work of taking out the ore is all that is being done.

Bay de Verde district in Newfoundland has benefited greatly the past year from the mining boom there, says The St. John's, Nfld., Herald, and is likely to enlarge upon this during the present season. The Iron Co. has named its headquarters Workington, and has 16 square miles of territory under lease, all of it said to be rich in this mineral. They have two shafts sunk near there, two others at Island Cove and a fifth at Northern Bay. Stores, offices, sleeping quarters, and messhouses have been built, and a railway is laid to Perlican, so that there is every assurance that the property will be worked to the fullest possible extent.

A considerable deposit of kaolin—used in the manufacture of china—has been found to exist at Plow Rapids near the mouth of Stag Creek on the Gatineau. The place is about 40 miles from Ottawa and is owned by an Ottawa man. The kaolin was discovered first in 1860 by the late W. L. Holland. Samples of the material were later on sent to St. John's, Quebec, and to the United States where it was successfully used. It should be possible to successfully make use of this deposit in a country where electrical power is limited only by the amount of apparatus set up, the water power being unlimited.

The American Copper Mining Company, in its combination of six plants, expects, it is said, to control the copper mining industry of the world. The Boston and Montana and the Butte and Boston mining companies, the old Dominion Copper Company of Arizona, and the Arcadian, Tamarack & Osceola Mining Companies of Michigan are named as the component parts of the new organization. It is understood that the American company will reach into Canada and absorb important copper mines there, thus making the combination international, but the Calumet and Hecla Company, the largest producer in the Lake Superior region, has so far declined to enter the combination.

War Eagle Gold Mining and Development Co. has received a refund of $16,000 from the Trail, B.C., smelter, on account of the mine having furnished the stipulated 175 tons of ore daily for the past six months. During that time the shipments amounted in round numbers to 32,000 tons, and the refund was on the basis of 50 cents per ton. The War Eagle smelter rate is $7 per ton.

Marine News.

Nicholas and Michael Connolly have secured the contract from the Department of Railways and Canals to build a large wharf for the I.C.R. terminus at St. John, N.B.

It is now said that the "Pharsalia," the latest addition to the battle line, will be launched at an early day. Captain Smith of Yarmouth, N.S., and formerly in the "Arbela," will command her.

The White Star Line steamer "Oceanic," the largest ship ever built, was successfully launched at Harlan & Wolff's yard. Belfast, Ireland, January 14th, in the presence of an enormous crowd. A grand stand was specially erected to accommodate 5,000 persons.

Incorporation is being sought for a company to construct a canal or ship canal for navigation from some point on Lake St. Clair, in the county of Essex, or in the county of Kent, to some point on Lake Erie between Point Pelee and Rondeau Harbor.

G. N. Ducharme, Ste. Cunegonde; M. F. Pauze, Montreal; A. A. Bernard, M.D., St. Henry; L. A. Bernard, Montreal; T. Bienvenu, Labelle, Que., are to be incorporated as the Lake Labelle Navigation Co., Ltd., Montreal. The capital of the company will be $10,000.

R. Roy, Dominion engineer, has started a large gang of men to work to improve the navigation on the Kootenay River from Fort Steels to Wardner, for which a grant of $5,000 has been given. The bulk of the work will be done on Wild Horse bar, which is the worst impediment to navigation.

The Richelieu and Ontario Navigation Company will put on a daily service up the Saguenay next summer and the Hamilton service will be augmented by additional vessels. The steamer "Saguenay" will be renovated this winter and new boilers and electric plant will be introduced.

The latest addition to the fleet of the Dominion Atlantic Railway steamers, the "Prince George," is proving a very fine ship; she has now been making regular trips for some time between Yarmouth and Boston. The sister ship, "Prince Arthur," now building at Hull, Eng., will probably be placed on the route in the spring.

A further proviso has been added to the contract with the Allan and Dominion steamship companies for the Atlantic mail service, by which the vessels of these companies will be required to await at Halifax the arrival of the Chinese mail, which by special contract with the Imperial Government is carried by the Canadian Pacific Railway.

At the annual meeting of the Great Northern Transit Company it was decided to build a modern steamer for the Sault Ste. Marie route to replace the "Pacific," which was recently destroyed by fire. It was also decided to purchase a new steamer for the North Shore route, to replace the "Belle," also destroyed during the past season.

Recently the Quebec Harbor Board granted an exemption from harbor dues to any ocean steamship line which would make it a regular port of call, and the Elder-Dempster Line made a contract. The board has also given permission to the Great Northern Railway to erect on the quay an elevator, with a capacity of 1,000,000 bushels, to be finished by May 1, 1900.

At the annual meeting of the Canadian Marine Engineers' Association the following officers were elected: Hon. president, O. P. St. John; president, Harry Parker (acclamation); 1st vice-president, A. J. Woodward; secretary, S. A. Mills; treasurer, H. Brownley; inside guard, H. Bowler; auditors, D. L. Foley and E. J. O'Dell; council, Thomas Good, William Horwood, Rees Binch, P. J. Carr and J. E. Kane, Port Dalhousie.

The Polson Iron Works Company, Ltd., Toronto, has been given the contract of building for the Richelieu & Ontario Navigation Co. a new boat, which will be a steel screw craft, 112 feet long, 22 feet 6 inches beam, to draw 6 feet of water, and to make a speed of 15 miles an hour. She will be fitted with a fore and aft compound engine and a Fitzgibbon boiler. The price is said to be $20,000. The steamer will be especially adapted for river service.

The Canadian Marine Engineers' Association held its fifth annual "At Home" in the Confederation Life Building, Toronto, February 1st. O. P. St. John, hon. president, occupied the chair and made an interesting and instructive speech on the advantages of education along technical lines to the engineer. A very good concert was given and a pleasant dance and excellent supper concluded the evening's pleasure. Among those present besides the members were noticed: J. R. Dillon, Hamilton; E. W. McKean, Sarnia; Wm. Lewis, Owen Sound; Capt. Rees, Kingston; D. McEvoy, Gutta Percha Mnfg. Co., Ltd., Toronto; A. W. Smith, Aikenhead Hardware Co., Toronto. The committee in charge of the arrangements were: O. P. St. John, H. Brownley, D. F. Campbell, T. Crossley, S. A. Mills, D. Foley, E. Abbey, H. Bowles, A. J. Woodward.

Personal.

Angus G. Macdonald, city electrician of Halifax, N.S., is dead.

Samuel Hall, one of the oldest employees of the Grand Trunk Railway at Belleville, Ont., died Jan. 4th.

James Cunningham, an engineer on the M.C.R., dropped dead in the Queen's Hotel, St. Thomas, Jan. 6th.

W. R. Campbell, general manager of the Dominion Atlantic Railway, died suddenly in London, Jan. 8th, after a short illness.

R. Patterson has been appointed master mechanic of the Grand Trunk shops at Stratford, Ont., in place of J. D. Barnett, resigned.

R. J. Armstrong, Fort William, travelling inspector of fuel and engines on the C.P.R., has had his office transferred to Winnipeg.

Capt. Thos. Donnelly, Kingston, has been appointed inspector for Lloyds, and will at an early date resign his position as Government steamboat inspector. The new position is worth $2,000 a year.

Yorke Kirton, formerly of the Lancaster Machine Works, and who has spent the past eight months in the employ of John Bertram & Sons, Dundas, Ont., is now employed in the cotton mills at Valleyfield, Que.

Lieut. Adams, R.E., formerly of Kingston, Ont., and a graduate of the Royal Military College, has been appointed to the important and lucrative position of manager of the Nile Delta Light Railway.

Ronald T. McDonald, the late president and general manager of the Fort Wayne Electric Corporation, while on a business trip to New Orleans, La., and Dallas, Texas, contracted a severe cold, which resulted in double pneumonia, causing his death December 24th.

E. A. Wilmot, Mem. Can. Soc., C.E., city engineer Victoria, B.C., was dismissed by resolution of the city council, January 26th. To be dismissed by this particular municipal council is no reflection on Mr. Wilmot's professional status, it is of course understood.

J. A. Sarvis, lately of Fort William, Ont., has been engaged as traveller by the B. Greening Wire Co., Hamilton, Ont. He will represent the firm in northern Ontario, thus allowing the secretary of the company, Mr. R. H. Merriman, to devote more time to the office.

John C. Gardner, late secretary and manager of the Canadian Manufacturer Publishing Co., Ltd., has been appointed president and managing director of the Might Directory Co., of Toronto, Ltd., vice J. M. Might, retired. Mr. Gardner has had a long experience in the directory business, having been some eight years in that special field before he went with the Canadian Manufacturer.

W. C. White, who is well-known in business circles in Montreal, died at his residence there a short time ago. Mr. White was a manufacturer of boilers and lead pipe. He was born at Paisley, Scotland, in 1829, and came to Montreal in 1853. In 1860 he became a boiler and boat builder, and at the time of the construction of the Victoria Bridge was a sub-contractor. Mr. White was the proprietor of a manufacturing establishment at Sorel, and there built a number of vessels for the Richelieu and Ontario Navigation Company.

The report of the death of Lieutenant Keating, son of the general manager of the Toronto Railway Co., shows that he sacrificed his life in an effort to save a wounded corporal. It was in the fight near Yelwa, on the Niger, and the little British force consisted of Lieutenant Keating, Corporal Gale and fourteen native soldiers. Corporal Gale was shot by the blacks, but Lieutenant Keating by cutting down several of the boldest of them brought the badly wounded corporal to the river bank. When helping him into the canoe the fatal shot was fired from a close ambush.

LITERARY NOTES.

A. O. Norton, Boston, Mass., U.S.A., has issued a very complete catalogue of his patent ball-bearing jacks and "Sure Drop" track jacks.

The proceedings of the eighth annual convention of the Association of Railway Superintendents of Bridges and Buildings have been issued in a volume of nearly 300 pages.

The 21st annual edition of the Maine Record, Cleveland, O., U.S.A., was published January 26th and comes to hand with 52 pages of advertisements and interesting reading matter.

The Standard Tool Co., Cleveland, O., U.S.A., which makes a specialty of electric welding, has forwarded us a catalogue of the electrically welded bicycle parts, which are a well known product of this firm.

At the October meeting of the American Institute of Mining Engineers, H. H. Stock read a paper on the history of the International Correspondence Schools, Scranton, Pa., U.S.A., which has now been issued in pamphlet form.

The Mechanics Supply Co., Quebec, has just issued catalogue "M," which deals exclusively with acetylene gas fittings, etc. This is commendable enterprise, as it is the first catalogue of acetylene gas fixtures which has reached us.

The Hamilton Bridge Works, Ltd., Hamilton, Ont., has many points of interest in its 1899 catalogue just received. The illustrations showing the various recent works of the firm are very well done. The catalogue will be sent free on application.

Charts for Low Pressure Steam Heating for the use of engineers, architects, contractors and steam fitters is the title of a very comprehensive publication prepared by J. H. Kinealy, D.E., Mem. Am. Soc. Mech. Eng., and Am. Soc. Heating and Ventilating Engineers. We shall make further reference to this valuable work.

The Model Engineer and Amateur Electrician has reached us from London, Eng. It is a journal of mechanics and electricity for amateurs and students.

The Technology Review has just issued its first number. It is a quarterly magazine relating to the Massachusetts Institute of Technology, and is published at 71 Newbury street, Boston, by the Association of Class Secretaries.

The British Fire Prevention Committee has just issued as No. 12 of its official publications, the Effect of Fire, which is a report on the Horne building fire in Pittsburg, U.S.A., by G. Kaufman, C.E.; E. Swenson, C.E., and F. L. Garlinghouse, C.E.

The Canadian General Electric Co. has issued a handsome calendar for 1899, which is decorated with a picture of a female figure operating an electric search light whose rays fall upon the extensive works of the company at Peterboro, and show up brightly that huge industrial hive.

We have before us the profusely illustrated catalogue of the Unbreakable Pulley and Mill Gearing Co., Ltd., West Gorton, Manchester, Eng. It is a most valuable work on power transmission, entitled the Economical Transmission of Power, and contains over 150 pages of the most condensed information, many pages of statistics and other tabulated facts, which are of interest to all users of power.

We have received a circular from the Committee of Organization and Administration of the Congreso Industrial of Argentino, Lorea 80. It is proposed to hold an Industrial Exhibition at Buenos Ayres, capital of the Republic, in the month of May next. Exhibits will not be received after April 15th. Foreign exhibitions besides receiving diplomas without cost will have all the rights in connection with the exhibition that belong to natives of the country.

It is proposed to hold at Toronto in May an Historical Exhibition under the auspices of the Ontario Historical Society. The exhibition is intended to be both attractive and instructive, to illustrate the history of Ontario in particular, during the century now ending, and to demonstrate the progress of our people along commercial, social and intellectual lines; the history of localities as well as of the entire province; the advancement made in social and domestic comforts; and in scientific and domestic economy. It is not intended, however, to confine the exhibits to Ontario, although it should be given first place, but to include anything relating to the history of Canada. The Ontario Historical Society has already available the nucleus of such an exhibition, and it is believed that the various local societies and a large number of generous citizens will lend enough additional material to make this one of the most comprehensive and representative exhibitions of the period. All exhibits loaned will be properly taken care of and their safe return guaranteed. The proceeds of the exhibition are to be devoted towards the establishment of a permanent historical museum. Miss Fitzgibbon, 1 Avenue Chambers, Toronto, is the secretary of the exhibition committee.

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FOR THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

ARTICLE 3.—TIES.

Ultimately we may expect metal ties to take the place of wooden ones. In Europe, with dear wood and heavy traffic, substantial progress has already been made. In America experimental pieces of track have proven satisfactory in cheapening maintenance, and for many reasons, to be enumerated, we may expect progress to be considerable in the near future, but for many years wooden ties will continue, on this continent, to be the rule, and metal ones the exception, although their use constitutes a heavy drain on our forests, which probably amounts to six or seven million ties per year for Canada alone.

Wooden Ties.—Wooden ties are in general use because they are cheap, and simple in use or renewal, and by the use of preservatives their life may be increased considerably. In Belgium and adjacent countries where mild steel ties are in use, wooden ties are being abandoned in favor of steel ones on the following grounds:

(1) That their price will gradually rise owing to the devastation of forests.

(2) The quality of even the best varieties of wood is variable and an unknown factor, being affected by time of felling, place of growth, seasoning, etc.

(3) Preservative methods fail to produce a uniform material for use.

(4) No timber merchant will guarantee ties of wood, while two-year guarantees can be obtained for steel ties.

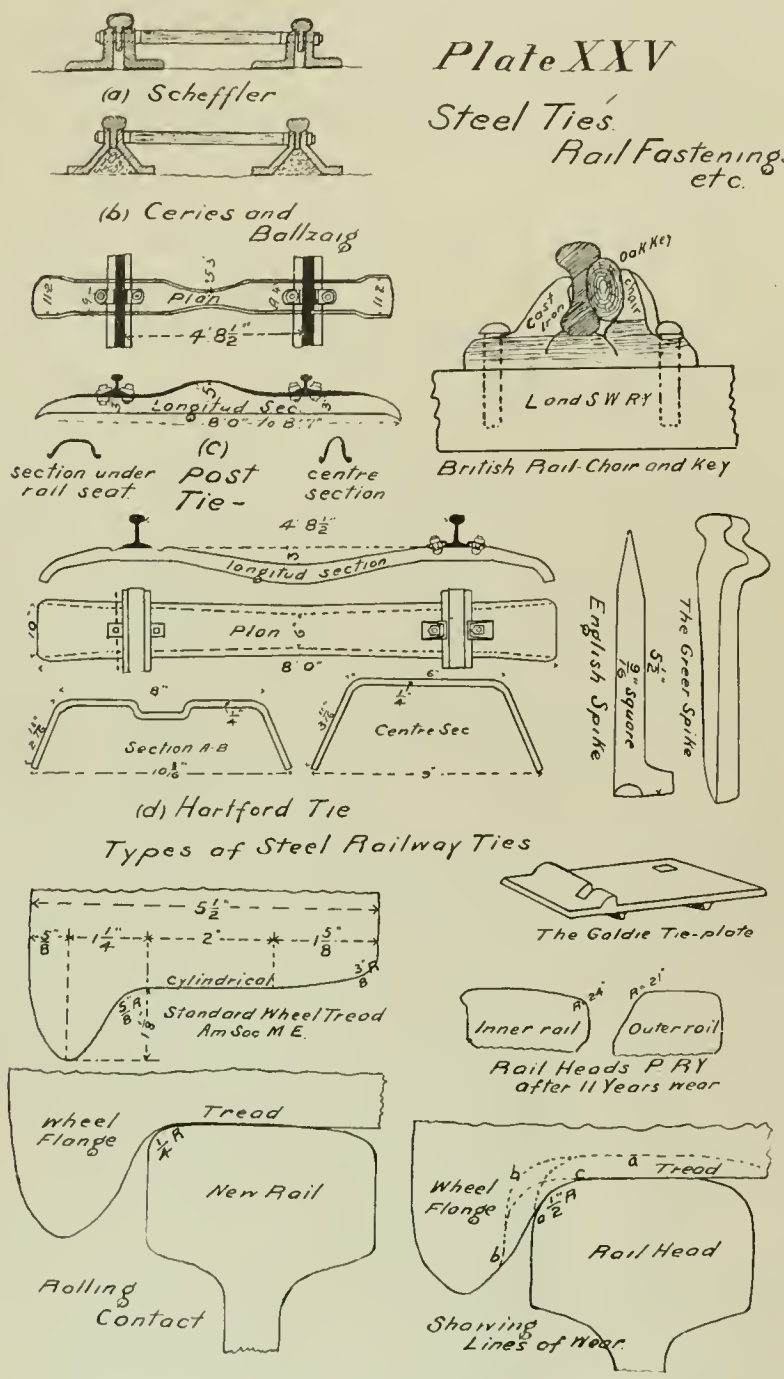
(5) There is a loss of interest, due to stacking wooden ties for seasoning, whereas steel ties may be in use, legitimately, even before being paid for.

(6) The difficulty of obtaining a good fastening of the rail to wooden ties, and the constant re-spiking necessary.

(7) The selling price of old wooden ties is less than metal ones even in proportion to their first cost. All of these objections are more or less valid, even in America, but the lasting and holding qualities are most important. Ties are ordinarily 8 ft. to 8 ft. 6 inches long, 6 to 7 inches thick, and 6 to 9 inches wide on top and bottom. They may be hewn or sawed, the former method producing a more durable tie if not hacked too deep before hewing. The top and bottom faces of a tie should be true and parallel planes, all bark being removed, and in sawed ties the removal of sapwood on the sides will add to their durability. They are usually laid 2 feet centres (2,640 per mile). The two ties at an ordinary angle-bar joint being selected as the widest ones near at hand and placed about 18 inches apart, centres, centrally about the joint, giving a suspended joint, but if the long six-bolted 44 inch angle-bars are used, then three ties are placed at a joint 18 inches apart, centres, one at each end and one in the middle; otherwise it is considered best to sort ties into groups of nearly the same width. It is believed that a random mixture of ties of various widths tends to cause poor track, as the narrow ones will sink more than the wider ones.

Ties are made from lignum vitæ, oaks, chestnut, locust, cedar, pine, maple, cherry, red elm, hemlock, tamarac, beech and spruce, being named, roughly, in order of durability in track, without treatment by preservatives. The life of a wooden tie in track, untreated, varies from 4 to 6 years for the poorer kinds, up to 10 or 15 years for the more durable ones, except lignum vitæ, which lasts 30 or 40 years. The length of life will depend on locality of growth, the kind and amount of ballast used, drainage, amount and speed of traffic, whether the tie is on a curve or tangent, and finally whether the rail rests directly on the tie or on a tie-plate or metal chair of some form. The wear on curves is greater than on tangents, due to the cutting into the ties of the rail base, which accelerates the rot; also, respiking is more frequent on the former: taking the life of a tie on a tangent as 9 years, one on a 2° curve will last about 8 years, 6° curve 7 years, 15° curve 5 years. Softwood ties can scarcely be used in America, owing to the poor hold of the ordinary dog-spike, which cuts and crushes the fibers of soft woods, while with hard woods the fibers are only squeezed back and are still elastic; but in England, with large metal chairs, soft-wood ties are in general use, and attempts have been made here to use cedar alternately with oak, as they both last well, and the latter will hold the spikes; also attempts have been made to nail oak planks on top of soft-wood ties, dove-tail oak bearing pieces just under the rails, and in other ways dodge the main issue, which is the poor holding power of

the spike, but none have been very successful. Metal tie plates such as the one shown on Plate XXV. are now used on heavy traffic roads, sometimes only on curves, and latterly under all the track. These spread the load over a larger surface, and are a great improvement, as they enable a cheaper tie and a deeper rail, relatively to its width of base, to be used. When railway managers in America see the wisdom of adopting wood screws or fang bolts, as in England, for holding the rails in place, a much superior track will be obtained even at a small increase of first cost.



There are several ways of increasing the ordinary life, in track, of a wooden tie, for a tie rots by the solidification of fermented sap, assisted by heat or dampness :

(1) By thorough drainage of the ballast.

(2) By having as little sap as possible in the tie by felling the tree in winter, and subsequent natural, steam, or other form of seasoning.

(3) By charring the surface.

(4) By impregnating the tie with an antiseptic to prevent fermentation.

Such chemicals as sublimate of mercury, sulphate of copper, chloride of zinc, and creosote or oil of tar, serve the purpose more or less successfully, especially the last two, and the last one most particularly. Creosoting is done in a closed receiver, after the tie has been air seasoned two or three months, and trimmed of its sapwood, by exhausting the air to suck out the sap from the pores of the wood. Creosote at 120° F. is then forced in at 10 atmos. pressure, and after one hour the ties are taken out ready for use ; soft woods, which are the only ones usually treated, absorb 7 to 9 lbs. per cubic foot, and the cost of treatment has been reduced from 21 cents in 1879 to 10 cents per tie at the present time. The increase in the life of ties in track is greatest amongst soft woods according to the following table :

Timber.	Duration in track. Untreated.	Creosoted.
Oak	13	19
Pine	7	15
Fir (Spruce)	5	9
Beech	3	16

Creosoted ties will not resist the cutting of rails more, nor are they stronger than untreated ones, but, especially in thickly settled countries, discarded ones will be more valuable as fence posts or fuel, being worth from $\frac{1}{5}$ to $\frac{1}{10}$ of first cost.

Creosoting does not assist ties to hold spikes, and in this respect wooden ties are deficient. Spikes with hardwood ties on roads of moderate traffic are one thing, with soft-wood ties or with any tie on heavy traffic roads are another. As they are continually being pulled loose by the action of passing trains, and have to be redriven, in the future, with heavier traffic, rails and engines, something must be done to remedy this weakness of American track, the solution of which will lie along two lines, either metal ties and appropriate fastenings, or oak or other durable ties along with tie plates, and fang bolts or wood screws as fastenings—either method will allow deeper rails to be used, or ties spaced farther apart.

Metal Ties.—Three types of metal rail-supports are used :

(1) Longitudinal flanged sleepers giving a continuous support to the rail, and held to gauge transversely by rods ; sections of these are shown on Plate XXV. (a) and (b) ; they have never come into anything like general use.

(2) A succession of cast-iron inverted pots, filled inside with ballast and connected transversely by rods, as in class (1) ; this method has been used in regions of brackish soils where cast iron rusts less than steel, and can be made heavier, as it is a cheaper material ; this method is also only in limited use.

(3) Metal cross ties of inverted trough sections are steadily increasing in favor and are likely to obtain, in the future, general adoption.

The tendency of metal cross-ties is to decrease maintenance charges year by year, while with wooden ones, especially on curves, the reverse is the case. Of these the Post tie seems to be the favorite in Europe; on the Netherlands railway, maintenance with metal ties was about one-half of what it was with oak ones, with thirty trains per day and engines of fifty tons, and no ties reported broken. A sketch of this tie is given on Plate XXV. (c) ; it is of mild steel, weighing 110 to 120 lbs. each, and costing a few years ago $22 to $26 per short ton, with two year guarantee. It is closed at the ends, narrow and deep at the middle, with thickness varying, being greatest at rail seats ; the bottom edges are in the form of ribs $\frac{3}{4}$ inch thick, projecting $\frac{1}{2}$ inch. The general thickness is $\frac{1}{4}$ to $\frac{1}{2}$ inch. The narrowing in and deepening at middle gives transverse strength, and prevents the track from creeping longitudinally, or forming a hog back at the centre. The rails are fastened by bolts with T heads and eccentric necks. These bolts pass through the tie from underneath, and into a crab washer which bears on the rail flange and tie ; a Verona nut-lock and a nut complete the fastening, and an oblong hole through the ties allows adjustment on curves. This tie presents economy of material and maintenance and general efficiency. It has been in long, extensive use in Belgium, Holland and France, and is probably the best metal tie yet devised for flanged rails. In the United States the Hartford tie has been used with

good results on the New York Central, and it appears in general to be an imitation of the Post tie, with an endeavor to simplify manufacture, see (d) Plate XXV. Other forms of less tried qualities are the Standard, an inverted channel beam, and the International, having a section like an elongated bracket ——'——, which would appear to be deficient in vertical stiffness. It is probable that persistent attempts at improvement will have a tendency to cheapen manufacture, and hasten the introduction of metal ties on many progressive railways having heavy traffic.

(*To be continued.*)

For THE CANADIAN ENGINEER.

SEWERAGE SYSTEMS OF ONTARIO.

BY WILLIS CHIPMAN, C.E.

The following tabular statement gives the extent and cost of the sewerage systems of the Province, excluding those of the cities of Toronto, Ottawa, Hamilton, London and Kingston.

	Population	Miles Sewers	System	Approximate Cost	Engineers
Barrie	6,000	3½	Separate	$ 27,000	Chipman, Ardagh
Belleville	10,000	5	S. & C.	65,000	Neilson, McDougall
Berlin	9,500	10	Separate	69,000	Bowman, Chipman*
Brantford	17,000	14	Separate	134,000	Chipman. Jones, T.H.
Brockville....	9,000	11	Separate	121,000	Chipman
Chatham	10,000	18	Combined	95,000	McDonell, McGeorge Topp
Cornwall	7,000	7	C. & S.	55,000	Chipman, Wiggins, Brown
Goderich . ..	4,000	4½	Separate	19,000	McDougall,† Brough
Niagara Falls.	5,000	11½	Separate	105,000	Mitchell, Chipman,†
Owen Sound..	8,000	7¼	Combined	48,000	Kennedy, McDowell
Peterborough .	11,000	7½	Separate	70,000	McDougall, Belcher
Petrolea	6,000	6	Combined	45,000	Jones, J. H.
Renfrew ..	3,000	4	Separate	20,000	Chipman
St. Catharines	10,000	6	Combined	70,000	Gardiner, Reynolds, Roberts
St. Thomas ..	11,000	46	Combined	150,000	Bell, Campbell
Sarnia	8,000	7	Combined	26,000	Jones, J. H.
Sudbury	1,400	1¼	Separate	10,000	Gordon, Rorke
Stratford	10,500	8½	S. & C.	70,000	McDougall, Van-Buskirk
Tor. Junction.	5,000	11	Separate	120,000	Chipman
Walkerville ..	2,500	4½	Combined	50,000	DeGurse
Waterloo	3,000	3½	Separate	20,000	Bowman, Chipman*
Welland	2,500	1½	Combined	7,200	Ross
Windsor	12,000	21	Combined	280,000	DeGurse
Woodstock...	9,000	11½	Separate	50,000	Davis

In those places where the separate system has been adopted, the sewers are modern in design, and have been constructed during the last ten years under the supervision of competent engineers.

In some places the sewers have been built street by street and year by year without reference to any general plan or system, and occasionally without the advice or assistance of an experienced engineer. In some few places a large amount has been expended, but to the present time they have few, if any, proper sanitary sewers.

Class A.—Barrie, Berlin, Brantford, Brockville, Niagara Falls, Renfrew, Toronto Junction, Waterloo.

Class B.—Cornwall, Goderich, Peterborough, Owen Sound, Sarnia, Sudbury, Walkerville, Windsor.

Class C.—Belleville, Chatham, Petrolea, St. Catharines, St. Thomas, Stratford, Welland, Woodstock.

In Class A have been included those places in which the majority of the citizens are now served with well built, properly designed sanitary sewers; and where all plumbing work and the laying of house sewers are done according to stringent rules and regulations under the city or town engineer's inspection, and full records kept of all such work. These are undoubtedly the best sewer systems in Ontario, not excepting the five largest cities of the province. Drains of wood and stone are excluded from these systems.

In Class B some of the places have almost complete sanitary systems, but they have no regulations or rules whatever governing plumbing, and no complete records are kept of work done. The other places in this class have partial systems now built, covering the majority of the streets, but the plumbing by-laws are very imperfect. Drains of stone and wood are also excluded from class B.

In class C have been placed: (a) Those places that have constructed a very few sewers or a main sewer, but in which the great majority of the streets have at present no proper sanitary sewers. The work done has been of a modern character, but only a commencement has been made towards a first-class sewer system. (b) Those places in which a large part of the expenditure represents the cost of box drains and sewers that cannot or should not be used for sewage purposes. It must not be inferred, however, that all of the places in class C are not, on the whole, as well sewered as those in class B.

* Consulting Engineer only.
† Designing Engineer only.

ROPE TESTING.*

BY GEO. A. M'CARTHY AND ERNEST G. MATHESON.

(*Concluded from last issue.*)

EXPLANATION OF THE TABULATED RESULTS.

The ropes are arranged in the table so that those of the same order are grouped together, and the results are the more readily comparable. Under the column, "Position of fracture":

U is an abbreviation for Upper.
L " " Lower.
T " " Thimble.
S " " Strands.
P " " Pin.

Where no mention is made of the number of strands broken, one strand is to be always understood. The extensions in most cases were taken over a distance of eighteen inches. In testing some of the wet specimens, however, the stretch was so great and the travel of the machine so limited that twelve inches was all that could be allowed over which to take the extensions. In the results no distinction is made between the percentages obtained from these two different lengths. In tabulating the position of fracture as centre, it is not to be taken that this fracture occurred exactly in the centre of the specimen; but was far enough from the fixtures at either end so that no damage could possibly result to the fiber. Therefore we can at once assume that wherever in the tests, a "centre" fracture is recorded, we in that case at least develop the absolute maximum strength of the specimen. The time of the test is given from the moment the load was applied to the specimen to the time when rupture occurred. The time of immersion in water before the wet test was made varied from forty-eight hours to one week, depending on the size and quality of the rope; the idea being to have the rope at least thoroughly wetted.

In the soaked tests, the ropes were in water on an average of about six weeks. The column showing the number of twists per foot is given instead of the "percentage of hard," which is referred to in the short description of the manufacture of rope.

Sufficient comparisons are here given to show that no regularity exists between the strength of one strand of a rope and the strength of three or more strands when they are formed into one rope. The result follows that if we have a rope of two strands and also one of four, we have no good reason for assuming that the one of four strands will be twice as strong as the other. The greater strength proportionately of one strand above two and two above

*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in THE CANADIAN ENGINEER.

TABULATED RESULTS.

DESCRIPTION OF ROPE.							DRY TEST.				WET TEST.				SOAKED TEST.			
MATERIAL.	No. of str'ds	Yarns per strand.	Circumference.	Weight per foot.	Twists per foot.	No. of feet of yarn per lb.	Load.	Per ct. of stretch.	Position of fracture.	Time in Min.	Load.	Per ct. of Stretch.	Position of fracture.	Time in Min.	Load.	Per ct. of Stretch.	Position of fracture.	Time in Min.
Manilla	3	11	2"	.124	6	360	3200	12.5	At tack in centre..	17	4875	19 0	At U. T.....	15	4800	22.0	On L. P.....	15
"	3	14	2.25	.156	6	360	3900	10.8	At U. toggle.....	12	6000	17.2	" "	12	5950	21.7	2. S. at L. T.....	10
"	3	17	2.5	.179	5 6	360	5150	12.5	At U. T.....	18	7175	20.8	" "	14	7025	20.2	At Centre	15
"	3	20	2 75	.246	5	360	6400	13.1	At U. toggle.....	17	7950	25.4	" "	15	8050	24.3	On U. P.....	13
Tarred manilla landyard, "Good Current"	4	15	2.5	.192	6	575	4400	16 9	2. S. at L. T.....	20	5520	20.3	2, S. on L. P.....	20	5400	21 7	2. S. on U. P.....	15
" " " " "	4	23	3 0	.278	5	575	6550	14.4	On L. P.....	20	7250	18.7	" " "	20	6900	18.7	2. S. on L. P.....	13
Tarred hemp landyard	4	16	3 0	.332	4 5	360	4800	12.2	2. S. on U. T.....	7	4900	10.2	3. S. on U.P.....	12	4700	13.8	On L. P.....	20
" " "	4	28	3.0	.338	5	575	5250	8.6	3. S. on U. P	20	6000	10.8	2. S. on U.P.. ...	14	5150	11.3	2. S. at U. T.....	20
Manilla boltrope	3	17	2	.113	6	575	3400	8.3	At U. T.....	12	5425	18.6	On L. T.....	13	6175	20.3	{At U. T..... / At L. T.....}	10
" "	3	27	2 5	.184	5.3	575	7000	12.2	" "	25	9250	18.6	At U. T	17	9500	19.6	2. S. on U. P.....	12
" "	3	38	3	.265	4	575	8300	10.8	At U. toggle	15	12510	25.4	On L. P.....	25	13600	18.3	At L.T.....	15
Manilla boltyarn	3	27	2.5	.195	5.3	575	5560	13.1	2. S. on U. P.....	25	7600	20.3	2. S. at L. T.....	13	6535	20.8	At Centre.....	17
" "	3	38	3"	.290	5	575	8100	15.3	On L. P.....	12	10050	23.3	At L. T.....	15	8100	25.2	On L. P.....	15
Manilla	3	2	0 9	.018	15 6	400	425	10.6	On L. P.....	20	750	15.8	At L. T	12	880	19.7	Centre.....	10
"	3	3	1 0	.014	13.3	400	800	8.6	On U. P.....	15	1170	19.1	At upper tack....	14	1025	20	"	8
"	3	4	1.1	.035	12.3	400	1050	11.1	At centre	14	1450	16 6	At U. T.....	7	1500	18	"	10
"	3	2	1.0	.021	15.6	360	700	8.0	At centre	15	825	16 6	At centre.....	6	900	18.8	At U. T. & Centre..	8
"	3	3	1.2	.034	12.6	360	900	11.1	At U. T.....	20	1525	20	"	8	1375	22.8	Centre	12
"	3	4	1 4	.037	10.3	360	1100	10	At centre	15	1800	21.9	At U. T.....	8	1825	21.0	"	12
"	3	5	1 5	.048	9	360	1650	10.3	At L. T	16	2300	18.3	At lower tack....	11	2550	21	"	10
"	3	6	1 65	.063	7.6	360	2175	15.0	At centre	7	2875	21.7	At L. T.....	10	2750	20.4	At L. T.....	12
"	3	7	1.6	.064	7.3	360	2450	9.4	"	15	3100	18.2	At U. T.....	13	3175	19.6	Centre	13
"	3	8	1.8	.075	7	360	2450	10.8	At U. Toggle.....	15	3650	19.4	" "	10	3700	23	At L T.....	10
Tarred manilla	3	2	1.0	.021	14.6	360	600	5.5	Centre.....	14	755	11.7	At centre	11	950	17.1	Centre.....	12
" "	3	2	1.25	.034	13.6	360	850	8.3	"	12	1200	16.1	On U. P	25	1275	19.2	"	10
Tarred manilla boat hawser	3	12	2.15	.105	6.6	375	1950	17.5	At U. T.....	15	2650	24.4	At U. T.....	30	2820	25.8	Whole rope at U.T.	27*
Sisal "oiled"	3	2	1.15	.024	13 6	360	650	14.4	At centre	25	600	24.7	At centre	20	600	28.3	Centre.....	11
" "	3	3	1.25	.028	12	360	750	10.7	On U. P.....	15	750	18.8	At U. T.....	15	800	22.2	2 S. at Centre....	8
" "	3	4	1.5	.041	9.6	360	1100	9.6	At centre	12	1050	28.8	" "	12	1000	22.2	Centre	10
Tarred hemp ratline	3	2	1.0	.022	13 3	..	460	4.7	2. S. at centre....	12	400	8.6	On L P.....	5	590	9.4	At L. T.....	9
" " "	3	3	1.23	.036	12	..	850	5.5	2. S. at L. T.....	10	750	12.8	At Centre	7	800	12.5	At Centre	9
" " "	3	4	1.44	.052	10.6	..	1000	8.6	At L. P.....	10	1000	13.8	2. S. at lower tack	10	1075	13.1	At L. T.....	8
" " "	3	5	1 5	.063	8.6	..	1100	7.5	At L. T.....	10	1300	12.5	At U. T.....	15	1120	13.3	At Centre	8
" " "	3	7	1 7	.09	7.3	..	1350	6.1	At U. T.....	10	1433	14 4	At L. T.....	15	1450	13 9	"	10
Tarred hemp boltrope	3	2	84	022	12	..	525	3 1	2. S. U. T.....	10	600	9.4	At U. T.....	12	800	12.2	At Centre.....	10
" " "	3	4	1.08	.027	11.3	..	700	5.3	" "	10	740	10.0	At centre	11	700	15.3	"	8
" " "	3	5	1.16	.034	9.3	..	650	5.3	2. S. at Centre....	10	800	11 1	"	12	900	11.9	"	8
" " "	3	6	1.2	.042	9.3	..	925	6.6	" "	12	1000	12.2	"	15	1050	12.5	2. S. at L. T.....	7
" " "	3	11	1.7	.08	7	..	1500	8.3	2. S. at U. T.....	13	2000	12.8	At U. T.....	12	2025	13 1	At U. T.....	12
Tarred hemp boat hawser	3	12	1.9	.108	7.3	..	1375	11.7	" "	11	1950	20.8	2. S. at centre.....	15	2125	21.6	2. S. at U T.....	10

* In this test had to run machine back owing to stretch.

three is no doubt due in some measure to the strands after the first breaks becoming more nearly straight, thus enabling the stress to act along the direction of the length of the fibers. The three strands were broken where rupture took place near the centre of the specimen, so that we got the absolute strength. In the ropes which contained the greatest number of twists to the foot, the irregularity between the comparative strength of three strands, two strands, and one strand was the most noted. This would appear to bear out the deduction just referred to, namely, that the proportionately less strength of three strands as compared with two, and one, is due to some extent to the less twist per foot in the two strands, and one strand, after the first and second strands break.

REMARKS ON EXTENSION CURVES.

The extensions shown on the curves are (for diagrams of these curves, see CANADIAN ENGINEER for February) the amounts the ropes stretched under the different loads in a distance of eighteen inches. In the same diagram each of the three curves gives the average results of the untarred or tarred rope, as the case may be, in three different conditions, viz.: dry, wet and soaked. Diagram for untarred manilla and hemp rope: Here it will be noticed that the ratio of stretch to load is least for the dry rope, while those for the wet and soaked do not differ widely. The two curves are, however, quite different in shape. The soaked rope stretched less at first, but its curve soon crossed that of the wet rope by its stretch becoming greater. Then the stretch of the soaked specimen became less than the wet, as is shown by the two curves again crossing. At the upper limit of the load the two curves run nearly parallel. It would appear as if the great shrinkage in the soaked specimen at first resisted the load up to a certain point and then suddenly yielded somewhat more rapidly than the wet specimen and nearly finished stretching at the same time. This latter truth can be seen at once from the curve of the soaked rope by noticing how nearly vertical the curve is at its upper limit.

TABLE SHOWING COMPARATIVE STRENGTH OF ROPE BEFORE FIRST STRAND BREAKS, AND AFTER THE FIRST AND SECOND STRANDS BREAK.

Description of Rope.	1st Strand Break. Load.	2nd Strand Break. Load.	3rd Strand Break. Load.
Manilla	3,200	2,750	1,150
"	6,000	4,425	1,800
"	750	650	425
"	1,170	950	575
"	1,525	1,100	800
"	1,825	1,425	1,000
"	2,300	1,775	1,025
"	2,175	2,000	650
Tarred manilla	1,275	950	455
" hemp ratline.....	750	640	475
" "	1,120	890	380
" " boltrope	740	600	600
" " "	800	650	425
" manilla "	5,425	3,400	2,000
" " boltyarn	6,535	4,475	2,600

In the diagram for tarred rope there is not such a difference between the stretches in the three conditions. What seems surprising is that the ratio of stretch to load is least not for the rope when dry, as in the untarred specimen, but for the rope when wet; while it is the curves for the soaked and the dry specimens which intersect. Moreover, it is the curve for the soaked tarred specimen which most nearly resembles the curve for the wet specimen in the untarred rope. It is also to be noted that the ratio of stretch to load decreases at an increasing rate, which decreases as we reach maximum load.

DEDUCTIONS FROM THE TABULATED RESULTS.

The most noticeable fact is that a wet rope is stronger than the same specimen dry. This was no doubt owing to the fact that the rope was more pliable so that it adjusted itself in such a way that the stress was more uniformly distributed; and none of the fibers were strained to rupture almost, before others had any considerable stress; for we found that when any of the outside fibers on a bend, which of course are strained most severely, gave way, the rope was practically at its maximum load. The above was an important factor in determining the position of fracture. A larger proportion of the failures took place at the upper pin or thimble than in any other position. This was particularly so with the larger ropes, where the outside fibers were affected not only by the direct stress, but by this stress acting at a leverage of the diameter of the rope, minus the crushed depth, in the same manner as the outside fibers of a beam in a transverse test are affected by the skin stress and the depth of the beam. We endeavored to place a sleeve on the pin, but the short distance between it and the head of the machine left barely room enough for the rope. This pin had no feather in it and turned round in its eyes, so that a greater portion of the stress developed in the specimen was transmitted down to the toggle end of the rope than would have been if the pin had had a feather to keep it from turning.

It will be noticed that a large number of breakages occurred at the upper thimble. We believe this to be due to the injury the rope may have sustained by the pin turning in its eyes, and not due to any defect in the method of fastening. The smaller number of breakages occurring at the bottom thimble, where the pin had a feather in it to keep it from turning, and where the fastening was similar to that at the top, would tend to confirm this.

Considering the bending moment referred to above it would be natural to conclude that a small rope would be less affected by it than a large one, and would be more likely to break at the centre. This was proved to be so by our tests. It may also be noted that the melting or soaking did not increase the strength of a tarred rope as much as that of an untarred. This would be expected, as tar allows motion of the fibers so that the stress is more uniformly distributed throughout the whole specimen. The increase in strength was greater in tarred manilla than in tarred hemp. Immersion always increased the strength of an untarred rope, but a continued immersion had no marked effect. It might be thought that the additional stretch of a wet or soaked specimen above that of a dry would be due entirely to the shrinkage. A comparison of results will show that this additional stretch is greater than the shrinkage.

CORROBORATION OF EXISTING FORMULÆ.

Most of the existing formulæ giving the strength of rope are very complicated and hard of application, but in "Jones and Laughlin's" hand book is the following formula: "To get strength of manilla rope, multiply the square of the circumference in inches by eight, and the result will be the number of hundred pounds required to break the rope." This agrees remarkably closely with the results of our tests; e.g., In the first rope of the tabulated results the formula giving the number of hundred pounds required to break the rope gives the following:

Load = $2 \times 2 \times 8 = 32$; breaking load = 3200. Exactly what we obtained. Again, take No. 3:

Load = $2.5 \times 2.5 \times 8 = 52$; breaking load = 5200, while we obtained 5150. Many others are equally near.

In submitting this thesis, we sincerely hope that the data tabulated, and the explanation given thereof, may be sufficiently lucid to all readers; and that the benefits obtainable therefrom may, in some degree, be commensurate with the labor entailed by its preparation.

For THE CANADIAN ENGINEER.

WATER WORKS EXPROPRIATIONS IN CANADA.

BY WILLIS CHIPMAN, C.E.

The following is a list of the cities and towns in Canada that have from time to time acquired their waterworks systems by purchase or by arbitration from the private companies that owned and operated the works, and the price then paid by the municipality:—

Montreal, P.Q.	1845		$250,000
St. John, N.B	1855		
Halifax, N.S.	1861		275,000
Toronto, Ont.	1873.	By arbitration	220,000
Kingston, Ont.	1887.	"	121,000
Niagara Falls, Ont.	1884.	"	17,000
Valleyfield, P.Q	1887.	By mutual agreement	
Brantford, Ont	1888.	" "	65,000
Owen Sound, Ont	1890	" "	55,000
*St. Cunegonde, P.Q.	1891.	" "	
*St. Henri, P.Q	1891.	" "	
Brockville, Ont	1892.	By arbitration	138,000
Vancouver, B.C	1894.	"	
Kincardine, Ont	1894.	By mutual agreement	40,000
Moncton, N.B.	1894.	By arbitration	265,000
Chatham, Ont	1895.	By mutual agreement	145,000
Cornwall, Ont	1897.	By arbitration	86 500
Sherbrooke, P.Q.	1897.	"	116,000
Barrie, Ont.	1898.	"	78,000
Berlin, Ont	1898.	By mutual agreement	102,000

In Ontario an Act of Parliament was passed in 1882 empowering cities and towns to acquire waterworks or gas works by purchase or by arbitration. Six towns have taken proceedings under this statute since 1891, and have acquired their works, three by arbitration and three by mutual agreement.

In the Ontario Act, the word "value" is clearly defined as structural value at the time this value is being determined. Ten per cent. is, however, to be added to this valuation by the arbitrators.

The Ontario Act prescribes two methods of procedure:—

(a) The municipality may submit a blank by-law to the ratepayers before an offer has been made or a valuation prepared, which, if carried, empowers the council to proceed with the arbitration or to acquire by purchase.

(b) The municipality may proceed with the arbitration and take up the award, then submit a money by-law to the ratepayers for the purchase of the works.

In either case if the works are not taken over, the municipality shall pay all costs of the proceedings.

Berlin is the only place in Ontario that adopted the first method.

In 1898 New Brunswick passed an Act similar to the Ontario Act of 1882, but none of the other provinces have any such legislation.

In the Moncton Act, the word "compensation" was used as well as value, but in the Campbellton Act the word "compensation" did not appear, and "value" is not so clearly defined as in the Ontario Act.

In the following cities and towns the waterworks are now owned and operated by private companies:—

Belleville, Cobourg, Ingersoll, Iroquois, Lindsay, Napanee, Perth, Peterborough, Smith's Falls, Stratford, Trenton and Waterloo, in Ontario.

Aylmer, Berthier, Chicoutimi, Cote St. Antoine, Drummondville, Granby, Huntington, La Chute, Richmond, St. Lambert, and Saint Johns, in Quebec.

Lunenburg, N.S.; St. Stephens, N.B.; Winnipeg, Man.; Calgary, N.W.T.; Esquimault, B.C.; and Nanaimo, B.C.

**These works were purchased by the municipalities in 1891, but soon afterwards they made arrangements with the Montreal Water and Power Company for a supply of water, and it is now reported that they are owned by this Company.*

THE SOULANGES CANAL.*

BY THOMAS MONRO, PAST PRESIDENT CAN. SOC. C.E.

At the close of 1888 the writer was transferred from the Welland Canal, and assigned the duty of determining the best location for a canal, having a navigable depth of fourteen feet, between Lakes St. Louis and St. Francis. After extensive surveys and examinations, he submitted a report, dated 15th June, 1889, addressed to the late John Page, M. Can. Soc. C.E., Chief Engineer of Canals, in which reasons were given why the new canal should be constructed on the north side of the St. Lawrence. Mr. Page died in 1890, and in June of that year a second report was addressed to the Secretary of the Department, confirming the views previously expressed. In that document the projected work was for the first time named the "Soulanges Canal." In a memorandum dated 25th January, 1891, prepared for the Right Hon. Sir John Macdonald, by Toussaint Trudeau, M. Can. Soc. C.E., Deputy-Minister and Chief Engineer of Canals, the scheme submitted by the writer was approved of in general terms. This view was subsequently confirmed by the Government, and, in August, 1891, a sum of $300,000 was voted by Parliament towards the construction of the Soulanges Canal, which was then estimated to cost $4,750,000.

Plans and specifications of the work were subsequently prepared; and in May, 1893, all the thirteen sections between Cascades Point and Coteau Landing were under contract. It is not intended to discuss in this paper the fitness or otherwise of the dimensions adopted for the Welland and St. Lawrence Canals. The writer's views on this important subject are fully set forth in his address on retiring from the office of president of this society on the 15th January, 1896. The object now proposed is to briefly describe the Soulanges Canal as it is, and to draw attention to the fact that in many essential features it differs in design from the other links of the St. Lawrence system.

It may be stated, at the outset, that more extended study of the question of the fluctuations of the St. Lawrence River led to the conclusion that it would be unsafe to accept previous records as a guide in fixing the heights of the mitre sills at each end of the canal. The lowest water at Valleyfield (1849-90) was in October, 1872; when it fell for part of one day to 10 ft 8 ins. on the mitre sill of the guard lock at the head of the Beauharnois Canal. But the mean for that month was 11 ft. 13 inches. Practically, 11 feet would therefore represent extreme low water during the navigation season. Adopting this view, the sills of the guard lock at the head of the Soulanges Canal should have been placed 3½ feet lower to secure a fourteen feet draught. As a matter of fact, the sills of the Soulanges are 5 feet lower than those at Valleyfield; and it is due to this that, in November, 1895, when the lowest water occurred, of which there is any reliable record, there was a depth of 14.55 feet at the upper entrance, and 14.83 at the lower end of the Soulanges Canal. In the same month there was only 13 50 feet at the lower entrance of the Cornwall Canal, and 13.08 at the head of the Lachine Canal. Attention is drawn to these facts, because between the time when the estimate attached to the writer's report of June 18, 1890, was made, and the letting of the works, the bottom plane of the summit level (10½ miles long) and the foundations of the structures on it, were lowered about 1½ feet, largely increasing the quantities, and adding, at a fair valuation, about $500,000 to the estimated cost of con-

*A paper read before the Canadian Society of Civil Engineers.

struction, which, instead of $4,750,000, should be placed at $5,250,000.

It may also be stated that in previous canal surveys along the St. Lawrence, various datums were employed, making the results somewhat confusing, or only intelligible after a good deal of trouble. An attempt has been made to avoid this by referring the levels of the Soulanges Canal to mean tide at New York. To do this, lines were run from a bench mark established by the United States coast and Geodetic Survey at Rouse's Point, N.Y., to the head of the Beauharnois Canal. In this way the mean level of Lake St. Francis was found to be 154.80; and directly connected with the records at the Valleyfield lock since 1849. The United States Army Engineers have determined the mean height of Lake Ontario (1860-75) at 246.61 above the same datum, so that the difference between Lakes St. Francis and Ontario should be (to close the circuit) say 91.81 feet. Lines run under the writer's direction between Coteau Landing and Kingston confirmed these figures. But the previously accepted distribution of fall was found to be quite erroneous. The descent from Kingston to Prescott was supposed to be three or four feet. It is now approximated at about one-third of a foot, pending the completion of the precision levels begun some years ago under the able direction of Rene Steckel, M. Can. Soc. C.E., of the Public Works Department. This work has not yet been continued along the St. Lawrence above Lachine. It may be stated, however, that levels recently taken by the engineers of the United States Deep Waterways' Commission only differ 0.12 from the figures given above as representing the relative levels at Rouse's Point and Valleyfield--about 47½ miles apart.

Attention was drawn to the lithographic profile of the St. Lawrence, prepared for the Canadian Deep Waterways' Commission of 1895, as explanatory of the foregoing remarks. This profile shows the position and length of the various canals between Kingston and Montreal. The fall in the river is about 220 feet. That overcome by locks is about 204 feet. It will be seen that Lake St. Francis is 33 miles long. It is merely an expansion of the river—a pool above the rapids between it and Lake St. Louis. The fall between these lakes is 82½ feet at mean water. In this distance of about sixteen miles there are the Coteau, Cedars, Split Rock and Cascades Rapids. At some points on the river there is a depth of not more than six feet in the channel at extreme low water. It is to surmount these rapids that the Soulanges Canal has been constructed. Its position is shown on the small sketch map which accompanies this paper.

The canal is 14 miles long, and leaves the foot of Lake St. Francis at Macdonald's Point, just below the village of Coteau Landing. Thence it runs straight 1½ miles, touching the margin of the river about a mile from the upper entrance. From the end of this tangent the line sweeps round to the north-east behind the village of Coteau du Lac for about three miles on a curve of 14,324. radius. It is then continued by a second tangent of some 8½ miles long, passing about a mile inland from the Cedar's Village. At the termination of this, the line bends slightly to the north, and is led straight into the Ottawa River, about two miles from its junction with the St. Lawrence at Cascades Point. The canal is, for all practical purposes of navigation, a straight line throughout, and is two miles shorter than the route by the river. The fall of 82½ feet is overcome by four locks. 70 feet of this is at the Cascades end, where the bluff forming the right bank of the Vaudreuil branch of the Ottawa gives an opportunity of locating three of these in the first mile; each having a rise of 23½ feet. The original design was for five locks. This was subsequently made four, and, after extended examination, the writer, in January, 1894, proposed a further reduction to three. In this view he was sustained by Messrs. Shanley and Keefer, who were retained by the Government to advise in the matter. The height of these lifts constitutes a peculiar feature in the Soulanges Canal. There is an interval of over two miles between the third and fourth locks. The latter is about three miles from the lower entrance. Here the lift is variable. It is about 12½ feet at mean water of Lake St. Francis—but at extreme high periods it would (if this water were permitted to enter the canal) be about 15 feet. At the upper entrance there is a guard lock by which the surface level of the summit can be regulated without interruption or danger to navigation. At periods of high water, this will be used as a lift lock, but, at ordinary stages of the lake, its surface level will be that of the canal. It is needless to point out to this audience the necessity of this arrangement. Canal engineers of experience will admit that such a safeguard is indispensable. About 1,000 feet above lock No. 4 there are a pair of guard gates placed for safety to the lower locks in case of accident.

It will be observed that the surface of the blue clay along the summit reach gradually rises towards the west and culminates at the crossing of the St. Emmanuel Road, where it is almost level with top bank, being only covered with a thin layer of sandy soil. Wherever this clay was cut into by the prism, there was danger of slides, roughly in proportion to the depth of the cutting. This danger was greater on the north side, which intercepted the natural drainage towards the river, so that in time the slope became so saturated as to break loose and slip into the canal. In other words, by the excavation of a deep trench of such dimensions, a similar condition of things was set up as that existing along the bank of the St. Lawrence between Coteau and Cascades, where, from time immemorial, *deboulements* have occurred, causing in many places a wearing away, which in some cases is measured by hundreds of feet. One of these slides took place on the 25th October, 1897; when, without any previous perceptible warning, the north bank of the canal, for over a quarter of a mile in length, slid into the prism, taking with it the abutment of the St. Emmanuel bridge, which was thrown bodily forward about fifty feet into the centre of the canal. This occurrence is considered to be of so much interest as to warrant its being made the subject of a separate paper. To discuss it in detail at present would take up too much time. Slides have also occurred more or less for a mile or so to the west of the St. Emmanuel Road, but a plan of repairs has been adopted which will enable the north slope to be satisfactorily restored in time for the opening of navigation through the canal. Towards the crossing of the river Delisle, the surface of the blue clay lowers rapidly. At the river itself rock of the "calciferous" is encountered, and this alternates with the clays and sands of the drift formation for some two miles to the west. At the upper entrance the guard lock and surrounding structures are all founded upon solid rock. There are about 6¾ million cubic yards of clay of all sorts, and 300,000 cubic yards of rock of various kinds in the excavations for the canal.

The level of the bottom of the summit reach at the foot of the guard lock is 137.00 above datum. Ordinary surface of Lake St. Francis may be taken at 155.50, at which time there will be 18½ feet of water in the canal, equal to a cross sectional area of 2,534 square feet. Propellers

of the type now being built on the upper lakes to navigate these canals will have a submerged midships section of say 42 × 14 = 588 square feet, or less than one-fourth of that of the water area at mean level. This will permit of a fairly high speed through the summit reach, which it will be observed forms 75 per cent. of the whole length of the canal. The bottom of this reach has an inclination of 0.10 per mile. Top bank is level and 161.0 above datum. The cross section of the canal has, as before stated, been kept as nearly as possible uniform throughout. This will avoid the creation of cross currents, and facilitate the rapid navigation of the canal. The relation of the area of the vessel to that of the canal is a matter of much importance. Full depth under the keel is of great value, both for speed and safety. The whole question of the gain in time in relation to the cost of construction affords ample scope for further investigation. It does not appear as if a slight increase in speed where the canals are short in comparison with the length of natural navigation would warrant a largely increased outlay even where ample means are at hand. As to locks, it is believed that, as has been stated, "The single individual lock is better than the fleet lock, and can be operated more quickly—and the maximum facilities may be provided by duplicate locks. The lift of locks should be made as great as possible where conditions permit, as time is consumed by the number of locks rather than by the lift."

To return to a description of the locks. It was the writer's intention that these should be constructed wholly of concrete up to the level of the surface of the lower reach. In this particular the design was almost wholly frustrated, lock No. 4 only having been built on this plan. The nature of the foundation of all the locks having been previously indicated, it will perhaps be as well to describe the general features of lock No. 2, and thus avoid tedious repetition. It will be observed that the lock is filled and emptied through culverts in the side walls, from which cast-iron pipes 30 inches in diameter—ten on each side—lead into the bottom of the chamber. These pipes have about 40 per cent. greater discharging capacity than the culverts themselves. The lock will be filled in about five or six minutes, and this will be effected without subjecting the vessel to much surging or strain. At the head and foot of each culvert there is placed in a shaft (8 x 4 feet) operated from the coping a 6 x 6 feet sluice of the "Stoney" pattern. These are for the first time introduced into a Canadian canal. Their operation is, as will be seen by the drawings, exceedingly simple. They are in extensive use in Europe, and have given the best satisfaction in controlling large bodies of water. They are used for that purpose on the Manchester ship canal. It may here be stated that the details for these gates on the Soulanges Canal have been worked out and modified by Geo. H. Duggan, M. Can. Soc. C.E. This has been skilfully done; and it is believed that their operation throughout will prove quite satisfactory. The method of emptying and filling locks through tunnels in the side walls is considered to be entirely the best, and manifestly better than any system of filling from below the floor. The main object in adopting this plan was, however, to avoid that in vogue in the Welland Canal, where the filling and emptying is done through valves in the gates. This is objectionable from every point of view. It weakens the gates just where most strength is required, and weighs them down with cumbrous valve gear. Besides, it introduces the water for filling so as to strike the stem of the vessel heavily, creating unnecessary disturbance in the chamber and a tendency to surge it on the upper gates. All this is now well known to practical men, and need not be dilated upon here. It will be observed that each lift lock is provided with a heavy breast wall at its upper end, corresponding in height to that of the lift. These walls have been re-introduced for the purpose of removing the cause of about nine-tenths of the accidents which have occurred on the enlarged canals; namely, vessels carrying away the upper gates of the locks by striking them whilst entering from the lower reach. It is difficult to understand why all the four gates of each lock on the Welland and other canals were made the same height—but there is no doubt the plan is defective. If a vessel goes ahead too far in a Soulanges canal lift lock, she will strike against the breast wall, and damage herself instead of the gates. The filling and emptying of the lock having, it is believed, been secured in a reasonable time in the way above described, it may now be stated that an attempt has been made to simplify the manner of working the gates by the use of struts in the manner shown in the accompanying drawings. An inspection of these will render further description unnecessary. It may, however, be noted here that the writer made a series of experiments in 1894 at Lock No. 9 of the Beauharnois Canal, which convinced him that this method would prove entirely practicable. Since then machinery of a similar kind, but on a greatly larger scale, has been and is now in operation on the North Sea Canal

The distribution of lockage as above described is supplemented by a series of weirs for the passage of the necessary supply. That at the head of the canal has four openings 9 x 10 feet, furnished with gates of the "Stoney" pattern. The tops of these gates will be submerged when hoisted. This structure is connected with a raceway of large dimensions formed to the south of and parallel to the guard lock. This channel is about 650 feet long, and is pitched on both sides. It passes into the canal through a series of masonry arches, and will amply fulfil the intended purpose without creating objectionable currents. About five miles from the upper entrance, at the crossing of the à la Graisse River, a large weir has been constructed having six arched openings 6 x 6 feet. It will regulate the summit level of the canal, which can be either lowered or entirely emptied at this point. The channel from the weir connects directly with the river à la Graisse a short distance from its junction with the St. Lawrence. In connection with this weir, a power-house is being erected which will be alluded to further on. The supply is passed by the guard gates above lock No. 4 through two 20 x 22 feet Stoney sluices; and at locks 4, 3, 2 and 1, the regulating weirs consist of twin culverts through the dividing embankments between the various reaches, having submerged gates controlled from top bank level through shafts of concrete and masonry. It will be observed that the water for supply is not in any case passed over breast walls, the writer's experience being that such an arrangement is objectionable in this climate.

There are seven road bridges and one railway bridge across the canal. The latter traverses the lower wings of the guard lock, and carries the Canada Atlantic Railway. It swings over the lock and raceway, and is about 180 feet long. The superstructure of this bridge was manufactured and erected by the Dominion Bridge Company, of Lachine, Que. At the head of this lock there is another swing to pass the main road between Coteau Landing and Cascades Point. A similar structure will be erected at lock 3 in connection with the Quinze Chiens Road. The superstructure of these two small bridges is from the shops of the Weddell Company, at Trenton, Ont. The remaining five road bridges cross the full prism of the

canal, and have been designed to permit a full and free flow for the water, and so as not to impede rapid navigation. This is effected by building the pivot pier in a line with the toe of the south slope, between which and the foot of the north slope there is an opening of 100 feet. The bridges are 242 feet long, and the south half swings partly over the land and partly over a channel formed in rear of the pivot pier to give additional water section. It is believed that this is a considerable improvement on the old method of placing the pivot in the middle of the canal with a narrow channel on each side of it where vessels have to slow up, and often find it difficult to get safely past. The piers, abutments, etc., of these bridges are of concrete coped with cut stone. The superstructure was manufactured and erected by the Dominion Bridge Company in a quite satisfactory manner.

To pass the drainage of the country lying to the north, across the line of the canal, has necessitated a very large outlay. The first stream met with in descending is the river Delisle. This has its sources some sixty miles inland. Its catchment basin has an area of about 180 square miles, and during spring floods the flow is sometimes over 200,000 cubic feet per minute. The river is passed under the canal through four lines of cast-iron tubes 10 feet in diameter, laid in a trench fifty feet wide, excavated in the rock to the depth required. The tops of these tubes are two feet below canal bottom. At each end there are masonry wells, and at the north end the macadam road is carried over by arches of masonry and concrete. This structure has been found to answer the required purposes satisfactorily. At no time has there been, so far, a greater head than from 18 inches to two feet on it, whilst the position is such that no just claims for backwater can arise. In connection with this culvert there has been excavated a channel of diversion of considerable length and dimensions, which secured a good foundation for the structure and diminished the interruption from water which would have been inevitable had it been placed in the old bed of the river. It is believed that this plan should be followed where at al practicable. The next stream is called the Rouge River. Its flow during floods is about half that of the Delisle, and it is carried under the canal by two lines of tubes of the same diameter as those previously mentioned. The excavation for the foundation of this structure was carried down to boulder clay through a stratum of soft blue material, which gave a good deal of trouble through sliding during the progress of the work. A diversion channel has been formed here also, the sides of which are pitched with masonry laid in cement. At the à la Graisse River the water is carried by a single line of tubes 10 feet in diameter. The foundations of this structure are on piles driven some 25 to 30 feet to hard material. There are also two pipe culverts of small dimensions towards the lower end of the canal which do not merit particular description.

Now as to the dimensions of the canal itself. Ordinary prism is throughout about 100 feet wide at bottom with side slopes of 2 to 1. The banks or cuts are first formed to these and then a notch is cut to receive the stone protection lining. This reaches from four feet below to four feet above mean level in the summit. It is about 3 feet wide at the base, tapering up to about one foot on top, where it is finished by a rough coping. Between this coping (158.0) and the top of the bank (161.0) the surface of the slope is sodded, the sodding being returned about five feet on the level. On the north side of the canal a macadam road, 16 feet in width, will be formed throughout its entire length, the centre of which is 33 feet from the edge of the cut or bank on that side. This road was designed, not only for the sevice of the canal, but also to provide a means of intercommunication between the various farms cut across by the canal and the sideroads where bridges are built ; and so, if possible, reduce damages—a result which has not, however, been realized, as the sums paid for right of way are very much greater than was anticipated. The total quantity of land taken is about 950 acres, ample width having been secured throughout. Wherever practicable, material arising from the excavation has been used to widen out the embankments to give additional safety to the north side of the canal, where in-filling is fifty feet wide on top. On the south side it is generally thirty feet at least. The large amount of surplus material was spoiled either on land adjacent to the canal taken for that purpose, or wasted into the St. Lawrence river at several points. At the Cascades' end the excavation is of rock of the Potsdam formation, which affords a solid foundation for locks Nos. 1, 2 and 3. The upper extension walls of the latter lock are, however, of piles and concrete. The reach between locks Nos. 3 and 4 is in clay, upon which the piers and abutments of the St. Antoine Road bridge are founded.

At lock No. 4 solid material is from 30 to 35 feet below the floor line. The lock walls are therefore placed upon a foundation of piles and concrete. They are 36½ feet high, and, from careful levels taken before and after building, have not perceptibly subsided. The structures immediately to the west of lock No. 4, viz., guard gates, sluice abutments, retaining walls, etc., are all founded on the clay, which affords a sufficiently solid bearing. The road bridges at St. Fereol and St. Dominique are also built on similar material. The gates are constructed on what is called the "solid" plan, which consists of a number of superimposed timbers shaped to the required horizontal pattern and fastened together. The method is simple and in this case the strength is superabundant. One leaf of the lower gates of the high lift locks at the Cascades' end of the canal weighs over 90 tons in the air. The drawings were made by J. B. Spence, M. Can. Soc. C.E., and the gates have been constructed in a thoroughly workmanlike manner by the firm of J. & R. Miller, of Ingersoll, Ont., who have had very extensive experience in connection with the Welland and St. Lawrence canals. The timber used is principally Douglas fir which was hauled across the continent for that purpose. A number of spare gates are on hand in case of accident.

It is proposed to work a lock from one point on the south side, and about 20 feet back from the coping, where a switch cabin will be placed. This will be connected with the motors actuating the sluices and operating bars previously described. Suppose a vessel to enter the lock from the lower level. When her stem is up to the breast wall she signals, and the lower gates are closed. The machinery will effect this in a perfect manner. The gates will shut precisely and synchronously, and avoid any trouble from over-lapping, which often occurs now. This should be done in one minute. The lower sluices are then dropped and the upper ones hoisted, the lock being filled as indicated. When the water has risen to the full height, the upper gates are opened and the vessel passes out. The lockages should be easily made in from 12 to 15 minutes. But the saving of time at a lock, although of much importance, has been unduly magnified. The capacity of the canal at four lockages per hour on the basis of one-third westbound freight would be about 20 millions of tons in an ordinary season. Of course, this estimate is merely theoretical. But even if one-half of it is realized, it will require a good many ports like Montrea to handle such tonnage economically.

In the construction of the Welland canal locks, nearly every mitre sill on the line was forced up, causing great delay to navigation, annoyance, and much expense. The plan of mitre sill and bottom designed for the Soulanges canal will, it is believed, fully obviate these difficulties. It will not be possible under any imaginable circumstances to disarrange sills held down as shown on plan of lock No. 2; and which is a type of all the rest. It will also be seen that the mitre sills themselves are the only pieces of timber in or connected with the lock bottom, and these can easily be renewed when this becomes necessary. The extension walls above and below the locks and in immediate connection with their masonry should not be built on a twisting batter. Where these walls cease to be self-sustaining and become slope walls, they are sure to crack—and besides the bases of those of the lower ends of the locks are liable to be washed out by the strong currents created when they are emptied, and have a tendency to slide into the canal All the walls connected with the upper and lower entrances to the locks of the Soulanges Canal stand upon their own bottoms, and are therefore not liable to failure in the way alluded to. The macadam road which runs along the north side of the canal is carried past the locks by a series of ramps, the inclination of which does not exceed 1 in 8. To enable foot passengers to surmount the rise between the different levels, a flight of steps is provided on each side of the lower ends of all the locks.

Concrete has been introduced into the construction of these locks to an extent greater than heretofore in Canada. Since the plans for them were made, the use of this material has rapidly spread. But a few years ago experienced hydraulic engineers looked upon construction with suspicion, at least in this climate. This is not to be wondered at, because the cement (which is the life of concrete) supplied was of very inferior quality and manufacture. Now, however, excellent Portland is obtained at moderate rates. On the Soulanges canal the writer specified that cement of a certain quality should be supplied by the Government to the several contractors—and should not be purchased by them at all. The benefits of such a course are obvious. There is no inducement to supply an inferior article or to stint its use; both of which may happen with the ordinary type of canal contractor. It is better to remove the temptation than to depend upon the virtue of the individual. The specifications for the preparation of concrete do not offer any feature out of the common. Some 70,000 briquettes have been made for testing purposes in a quantity of about 200,000 barrels. Good clean sand and properly broken stone have been insisted upon; and so it is believed that this work is excellent throughout. Mixing has been done both by hand and machine, but in either case the product when carefully laid and rammed makes an unexceptionable hydraulic wall, whilst its cost per cubic yard is less than half that of masonry. Of course this varies with circumstances, but on the Soulanges canal its use is clearly suggested by the fact that in the excavation for the prism about 300,000 cubic yards of rock had to be taken out, which is excellent for concrete, but unfit for masonry. This supplied the 150,000 cubic yards required for concrete—also about 120,000 cubic yards for stone protection, lining together with over 50,000 cubic yards for macadam, repairs, etc., leaving a large surplus to be thrown to spoil. It will be seen on reference to the plan of road bridges that these structures are almost entirely of concrete, the copings only being of cut stone. This remark will also apply to the retaining walls, regulating weirs, etc. A large amount of concrete was also used in connection with the culverts under the canal, and in other positions too numerous to mention.

Time will not permit of more than a passing reference to the style of supply weir or regulating culverts designed for the canal. The plans will show details of construction. They can be made to control the levels automatically if so required. It will be seen that the weir at Lock No. 4 is connected with its south wall, and differs in construction from those at the lower locks. It is believed that the drawings and photographs will show with sufficient clearness the main features of the culverts under the canal to pass the Rivers Delisle, Rouge and à la Graisse. The casting of the ten foot tubes was done by H. Ives & Co., Montreal.

The site chosen for a power house to generate electricity for the operating of the locks, bridges, etc., and the lighting of the canal throughout, has many advantages, and will perhaps merit a brief description, which must close this paper. At this place the River à la Graisse crosses under the canal and joins the St. Lawrence about 400 feet to the south of it. The surface of the canal is as before stated at ordinary stage about 155.50 above datum. At such time the à la Graisse is about 135.00 or 20.5 feet lower. It is obvious that by drawing a sufficient volume from the summit reach and passing it through whee's, power can be readily obtained here; and from this site a free discharge can be had into a wide tail race connecting directly with the St. Lawrence on Government property where no claims for damages can arise. Of course the above height of 20.5 feet represents the fall on the River St. Lawrence between Lake St. Francis and the mouth of the à la Graisse. The amount of electrical power required to operate the locks, bridges and other structures, and to light the canal satisfactorily throughout its entire length of fourteen miles was carefully determined by the officers of the Royal Electric Company, who also worked out the details of the distribution and application of this power. They also provided designs and drawings for the power house proper, and the switch cabins at the various locks, together with the necessary specifications. The hydraulic development was entrusted to A. M. Rice, of Dayton, O., a gentleman of acknowledged skill and experience in such matters. He prepared plans showing the number and position of the wheels, tail races, etc. These have been partly carried out; and work will be resumed in the spring. The power house is connected with a regulating weir previously referred to, and which is intended to control the summit level of the canal without discharging a great volume of water through the Cascades locks. The works for electrical power plant have been recently let, and the whole system will be in operation next season. The canal will be efficiently lighted throughout, and, considering its position in the St. Lawrence system, this will be of great importance in securing safe navigation through it by night. The entrances at each end of the canal are wide, of full depth, and sufficiently commodious. It will be observed that there are concrete walls heavily coped with cut stone on the top of the cribs forming a permanent face work instead of the timber generally used in such positions.

There are a number of other matters of interest to canal engineers which cannot even be touched upon in this sketch. It will, however, be seen that an attempt has been made to provide an unobstructed channel of full dimensions for a fourteen foot navigation at lowest water, with a much less number of locks than has hitherto been deemed advisable to overcome a similar fall on the other canals of the St. Lawrence system. In construction

materials of a practically imperishable kind have been almost wholly used, and this fact, taken in conjunction with the improved methods of operating the locks and bridges, will, it is believed, largely decrease the annual expenditure for maintenance and operation.

The writer sincerely hopes that the beneficial results which must follow from the completion of the St. Lawrence Canals to dimensions capable of passing vessels of 2,000 tons will be realized to the fullest extent; and that the immense expenditure so pluckily incurred by Canada with her comparatively small population and limited resources may at last draw to our national route the current of European trade for which we have waited so long. The writer may be permitted to state, in conclusion, that, in his humble opinion, if such a large volume of traffic as may be reasonably expected on the completion of the St. Lawrence canals, has to be economically and quickly handled at Montreal—a very different condition of things to that existing there must be at once established and maintained. If not, the expected benefits to Canada will be largely neutralized, or the point of trans-shipment for grain in bulk, and whole cargoes, will be transferred to Quebec.

The thanks of the writer are due to John L. Allison, M. Can. Soc. C. E., by whom he was materially aided in the preparation of the general designs for the canal and its structures. He also desires to acknowledge the zeal and intelligence of C. R. Coutlée and A. J. Grant, MM. Can. Soc. C. E, to whom, together with a staff of juniors, inspectors, etc., the superintendence of the principal works was entrusted.

At the conclusion of the paper the magic lantern was brought into requisition, under the direction of Mr. Redpath, and Mr. Monro made an interesting running commentary on the pictures as they were thrown on the screen. His explanations were listened to with the closest attention, and a hearty vote of thanks was passed, on motion of Stuart Howard, of Montreal, seconded by Geo. A. Mountain, of Ottawa.

The chairman congratulated both the society and Mr. Monro on this valuable paper. This was the first annual meeting for which papers had been specially prepared, and the maintenance of this feature would add greatly to the interest of the meetings, and would increase the attendance.

Mr. Keating would be glad to know if Mr. Monro had noted any effect on the concrete from the action of the sun or frost. He had noticed that in Halifax, where there were sudden and extreme changes in temperature from rain and its accompanying temperature to below zero, the east side of the graving dock on which the sun had most power was badly scaled from the alternate action of the heat and frost —was the effect the same at the Soulanges Canal ?

Mr. Monro said that after three or four years' exposure there was no degradation, either from change of temperature or other cause. In reply to several questions he said that nearly all the cement used in the canal was foreign Portland of the best brands. There were five or six of these all about equally good, namely "Condor," "Jorson," "Alsen," "Dyckerhoff," "Hemmoor," &c. There had also been used some Canadian Portland of the "Star" brand, which was found to be an excellent article. The proportions used were 1 of cement, 3 of sand and 6 of stone, broken into cubes of about 2 inches. It was true that in the land slide of October, '97, the wall of concrete was thrown down, but it fell as a monolith, and in its whole extent of 80 ft. long by 26 ft. high, there was not a crack caused by the fall, and one could not put a penknife between the coping stone and the concrete. The question remains to be decided how far we can use concrete to advantage in canal work. He was convinced by an examination of the Manchester Ship Canal in 1891, and of the breakwater at Buffalo in 1892, of the effciency of concrete work for canals. When he saw the Buffalo breakwater it had been built for four or five years, and had been covered with enormous piles of ice and exposed to violent gales without any signs of weakness. He did not think the concrete at the Soulanges Canal cost on the average more than $5 or $6 per yard. While the proportions were as already mentioned, they sometimes used one of cement, five of sand and ten of broken stone, according to the nature of the work. The facing mortar was incorporated with the body of the concrete and mingled with it, the two being made at the same time. The concrete was made in thick layers, but was often dumped down in large lumps, and he did not believe in putting it down in thin regular layers.

Mr. Marceau commended the plan here adopted of returning to the breast-wall as a guard against accidents to vessels. The lack of a breast-wall such as this was the cause of nine-tenths of the accidents in recent years on our canals. As the breast-walls were placed in this canal, a boat could not touch the gates to break them.

Mr. Monro said the mitre sills were laid in masonry checks so that the timbers could be removed without disturbing anything. It often happened with the old locks that stones would get in between the gates, causing trouble. To avoid this he had iron plates six inches wide by $\frac{5}{8}$ inch thick put on the upper face of the sill and under the gate, so that when a stone got between the gate and the mitre, it was crushed without doing any damage to the gate. In reply to further questions Mr. Monro said the concrete was deposited both in the water and out of it. In the former case it was boxed in, and was frequently deposited a foot or more under water, but it set as well in one case as the other. The "slope protection" to prevent the wash caused by passing vessels, was here laid with smaller stones than in former works, as the small stones were less disturbed by the waves. These stones were laid down to a thickness of 3 feet at the bottom, shallowing to a foot thick at the top, the top being about 4 feet above the water level, and the bottom about 4 feet below the water level.

Prof. Bovey, on the conclusion of the paper, asked Mr. Rogers as to the crack that had developed in one of the locks of the Trent Canal. What was the length of this body of concrete, and was one section of it allowed to set before the next was added ?

Mr. Rogers said it was laid at regular intervals in horizontal layers, and the length of the wall was 40 ft.

Prof. Bovey did not see why a piece of work 400 ft. long should crack any more than one 40 ft. long. He did not think that contraction or expansion would account for it. He was glad to know that in this work and the Soulanges Canal, the Canadian brands of cement had given such a good account of themselves. There was now every prospect that Canadian makers would produce a quality of cement that could not be beaten by the product of any country in the world. Of special interest was the hydraulic lift lock referred to in Mr. Rogers' paper, and the whole work would not only prove a credit to the country but to the engineers in charge of it. He hoped that it would also prove to be fully as great a commercial benefit to Canada as Mr. Rogers hoped.

In reply to Mr. Leprohon, Mr. Rogers said the cement was tested to 250 lbs., but they had not called for any specific mixture of sand. In reply to Mr. Rust he said the cost was about $5.25 per cub. yd. Replying to Mr. Skaife he said the Canadian brands of cement used were the "Star" brand and the "Samson" brand, and they had given the best satisfaction. To a question by Mr. Kennedy he said the width of the crack referred to was $\frac{1}{8}\frac{1}{4}$ to $\frac{1}{3}\frac{1}{2}$ of an inch, this part being built on rock foundation. In cold weather it opened very slightly.

Mr. Butler (Napanee), observed with regard to the last point, that the co-efficient of expansion of concrete was about the same as that of cast iron. Now, when a large mass of concrete was built up it adheres to the bottom and becomes attached to the back, which causes friction through expansion and contraction. These forces of expansion and contraction have to be restricted by the inherent strength of the mass of concrete. It will expand in the least restrained direction, and if the wall was weaker in one spot than another it would there give way. It was not practicable to get that perfect homogeneity that would insure a long wall from cracking. If you walk along the concrete sea walls you will see these cracks occurring wherever they are not provided for. It was therefore better to build in blocks of reasonably limited size.

Prof. Bovey observed as to testing, that it was easy to lay too much stress on a test. The difficulty is that there is no uniformity of procedure among the testers themselves; so that no two testers will give the same results from the same materials. In all tests the neat test and the sand test should be carried out. Above all, tests should be made with a standard quality of sand, and under a definite pressure which should be the same in all cases. Even University tests were disputed; and to show how small a circumstance may affect the result, he cited a case where a test was returned from McGill quite different to what the applicant had looked for, when it was compared with another test. But he pointed out that in carrying out one of these tests a little of the cement had settled on the meshes of the sieve and had become hardened, thus materially altering the result when the same sieve was used again. This showed how important it was that all the conditions should be precisely the same in all tests. If we can eliminate these

differences we shall be able to show results with Canadian cements quite as good as any that can be shown across the water. He was pleased to move a vote of thanks to Mr. Rogers for his interesting paper. This was seconded by Robt. Surtees, of Ottawa, and carried.

METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports from Great Britain of interest to the metal trades during January, 1898 and 1899:

	January. 1898.	January, 1899.
Hardware	1,609	1,538
Cutlery	3,329	4 765
Pig iron	504	361
Bar, etc.	200	445
Railroad	50	..
Hoops, sheets, etc.	814	125
Galvanized sheets	1,976	488
Tin plates	11,617	5,685
Cast, wrought, etc., iron	1,573	997
Old (for remanufacture)	..	..
Steel	4,521	3,770
Lead	924	889
Tin, unwrought	301	2,515
Alkali	1,501	1,545
Cement	485	213

SILICA PORTLAND CEMENT.*

BY M. J. BUTLER, M. CAN. SOC. C. E., ETC.

Consulting Engineer to the Rathbun Co., Ltd., Deseronto, Ont.

Silica Portland cement, as manufactured in Canada, is a mixture in equal parts by weight of a high-grade Portland cement and clean, dry Silica sand, ground together to an extreme degree of fineness, in mills specially designed for the purpose.

The Portland Cement used has the chemical composition and properties shown below:

		PORTLAND CEMENT.
Chemical Analysis	Lime	62.0
	Silica	22.0
	Alumina and iron	12.0
	Magnesia, sulphuric acid, etc.	4.0
Fineness.	Residue on No. 100 Sieve—	
	10,000 holes to the square inch	8%
	Residue on No. 200 Sieve—	
	40,000 holes to the square inch	35%
Tensile Strength, lbs. Per sq.-in.	Neat cement mortar, lbs. per square inch:	
	One day in air, six in water	500
	One day in air, twenty-seven in water	600
	Three part standard sand	
	One day in air, twenty-seven in water	200
Soundness—Absence of Free lime Unhydrated.	Very great care is taken to ensure a Portland cement that is absolutely sound, i.e., free from unhydrated calcium oxide.	

The resulting Silica Portland Cement has the chemical composition and properties shown below:

		SILICA PORTLAND CEMENT.
Chemical Analysis	Lime	31.0
	Silica	61.0
	Alumina and iron	6.0
	Magnesia, sulphuric acid, etc.	2.0
Fineness.	Residue on No. 100 Sieve—	
	10,000 holes to the square inch	Nil
	Residue on No. 200 Sieve—	
	40,000 holes to the square inch	7%
Tensile Strength, lbs. Per sq.-in.	Neat cement mortar, lbs. per square inch:	
	One day in air, six in water	350
	One day in air, twenty-seven in water	450
	To one part cement.	
	One day in air, twenty-seven in water	200
Soundness—Absence of Free lime Unhydrated.	As silica in itself is wholly inert, the resulting mixture of sound Portland and pure silica must likewise yield a sound cement: the small percentage of lime is a further assurance against the possibility of a blowey cement.	

Portland cement and clean, dry sand are weighed into the tube mill in equal quantities by a continuous uniform feed adjusting device, and in order to make clear the process of grinding it will be necessary to give a brief description of the tube mill. It consists of a horizontal steel cylinder, 18 feet in length by four feet in diameter, lined with specially hard cast-iron plates, which slowly wear away. The mill revolves at the rate of 27 revolutions per minute, and is filled half full with flint pebbles. The sand assists the pebbles in the grinding action, being itself, at the same time, reduced to a very fine state. The cement is reduced to an impalpable powder and is thoroughly intermixed with the ground sand, in fact, each minute particle of silica is enveloped with a flour of cement. Silica Portland has all the good qualities usually found in the best Portland cement, and the question naturally arises: Why is it? How is it possible to add 50% of inert material to a barrel of cement, and by the mere act of grinding them together to secure practically the same cementitious value as before the addition? An effort will be made to explain the seeming anomaly, as compared with the fineness of the molecule, the finest ground particle is coarse, yet the more nearly we approach the ultimate molecule, the more nearly we render it possible for the elements present in the cement to unite together and crystallize into the silicates which form cement.

A barrel of Portland cement when ground to the finest degree commercially, practically has quite 50% of the material too coarse to admit of crystallization, the underground particles are for all practical purposes inert matter, sand if you please, the active cementing material is the impalpable flour. Now, in the case of Silica Portland, the whole of the cement is ground to this impalpable flour-like condition, and therefore in a position to do work; the silica is reduced to a minute degree of fineness also, but not to the same extent as the cement, each speck or particle of silica is enveloped, wrapped up, in a layer of flour-like cement and offers a clean, sharp surface for the cement to adhere to. All very finely ground cements show strong adhesive properties, hence we see the useful function the silica performs; it takes the place of primarily, the unground clinker, and secondarily, is an excellent filling material, wholly inert under the usual conditions to which cement mortar is exposed, and in itself is stronger than the unground particle of clinker it has displaced. Owing to the exceeding fine conditions of the material, when tested neat it does not give as high a tensile strength as the more coarsely ground Portland cement, yet when made up into mortar, with three parts of sand, it actually equals in strength a like proportioned mixture of the Portland.

It is a peculiar fact that mortars made from very finely ground cement do not show quite as strong a resistance to abrasion, although they excel in adhesive properties. Hence the concrete for pavements and such like work preferably should be made of Silica Portland, and the top wearing surface of the coarser Portland cement. There are certain uses which silica cements are peculiarly well adapted to. Speaking generally, all cases where the low percentage of lime is an important factor: Notably in lining digesters for the manufacture of sulphite wood pulp it has been found of the very highest value, in sewers where free ammonia or acids are likely to attack the mortar and in all such cases. In pointing fine stone work, the color and permanent properties are peculiarly valuable.

Silica Portland Cement has already largely entered the market and proven itself a valuable cement. The following partial list will show to what extent and the nature of the work where it has stood the test of experience: The Laurentide Pulp Co., Grand Mere, Quebec, 21,000 barrels in concrete masonry, floors, brick work, etc; Montreal Street Railway Com-

*Paper read before the Engineering Society of the School of Practical Science, Toronto

pany, in concrete and floors, etc., 2,500 barrels; Canada Paper Company, Windsor Mills, N.S., 1,000 barrels; W. W. Ogilvie, Montreal, 1,000 barrels; Holland Emery Lumber Co., Byng Inlet, Ont., for saw foundations, 750 barrels; Riordan Paper Mills, 1,000 barrels; Dalhousie street station, C.P.R., Montreal, masonry, floors, etc., 2,200 barrels; Longue Pointe Asylum, Montreal, 880 barrels; Ottawa, Ont., pavements, 3,500 barrels; Cornwall, Ont., pavements, 600 barrels; Waterloo, Ont., pavements, 900 barrels. It has also been used in sidewalks and pavements in Ontario towns to the extent of some 10,000 barrels. Among other users are the Grand Trunk and Canadian Pacific, Central Ontario and Bay of Quinte railways, Public Works Department, Ottawa; in all over 75,000 bbls. of Silica Portland Cement have been used in Canada, although the manufacture was not undertaken until the season of 1897. Arrangements are being made to double the output for the ensuing season. It has been said by rivals that this cement gives facilities for adulteration not equalled by other cements, and objections have been made by "smart Alecs" that they had plenty of sand without buying it in the form of cement. Of course all such objections are met at the outset with every new material. When Portland cement was first produced it had to undergo an equally hostile criticism, and this naturally brings us to consider the testing of cement, a subject on which there has been a great deal written. The following scheme conforms to the best thought and experience in the engineering world:

Testing.

Hot Bath Test.--Faja's apparatus is so simple and well-known that it is unnecessary to describe it, but let me draw attention to a point sometimes overlooked. The sample when trowelled on the glass, should be well worked up, the air and excess of moisture worked out, and the sample be covered with a wet cloth, otherwise drying cracks may show up across the thickest part of the slab. This drying crack is sometimes mistaken for an expansion crack and the cement condemned. Too much importance is sometimes attached to the fact that the sample leaves the glass. If, as is usual, smooth glass is used, the slightest jar will loosen the slab. If it preserves its shape and does not curl up or show fine hair cracks at the edges, there is no danger to be apprehended from free lime, in fact from the low percentage of lime present a blowey Silica Portland Cement is almost an impossibility.

Specific Gravity, Weight per Bushel, or other Density Test.—Silica Portland Cement weighs a little less than Portland cement. It is so very finely ground that for equal measures, owing to the greater bulkiness, it must weigh less. In any case, the old test of weight per bushel should be abandoned as being unscientific and misleading; offering as it does, a premium on coarse grinding. The specific gravity test is a delicate laboratory test and is one requiring a high degree of care and skill, as usually conducted by volumetric displacement, confined air, minute error in reading, a slight change in the temperature of the liquid used, or irregularity in measuring apparatus or weighing, may give widely varying results. The object of the test is to determine the density of the cement, i.e., the sufficiency of the burning; in other words the soundness, hence the hot bath test practically suffices and is much more easily made.

Tensile Strength.—Neat tests, as usually made, show Silica Portland to be slightly weaker than Portland cement, this is probably due to the fine grinding. Mortar tests, however, are the best of all, and show the real working qualities of any cement, and it is as a mortar maker that Silica Portland proves its good qualities.

Having satisfactorily determined the safe qualities of the cement, having shown it to be sound, strong, both in neat and mortar tests, all of which should be a condition precedent to beginning the work, it sometimes happens that still the concrete or masonry shows poor work. Well, what are we to do then? Condemn the cement? No; suspect the sand, examine the gravel or broken stone, the water, the temperature of the air, the methods of mixing and measuring the aggregates, depositing in place, ramming, etc After all, the cement is only one of the factors in the problem; for a complete solution we should investigate the whole of them. Do not try the experiment of building works out of cheap, lean concrete, consider the relatively small saving a few barrels more or less of cement amounts to in comparison with the value and importance of the work at stake. Your reputation as engineers will depend upon your capacity to do good sound work.

ECONOMY TEST OF A UNIQUE FORM OF FEED PUMP.*

BY F. MERIAM WHEELER.

During the past few years considerable attention has been given to the subject of steam economy of the auxiliary machinery on steam vessels, particularly those on warships, where a saving of coal has much to do with the steaming radius of the vessel. Under favorable conditions, as, for instance, in the full power trials of the United States warships, it has been found that in the case of the main feed pumps the average indicated horse-power developed by such pumps is about one-half of one per cent. of the I.H.P. of the main engines. I mention this fact to show that feed pumps use more power than any other pumps of a vessel. It will therefore be seen that the feed pump is quite an important auxiliary, and everything should be done to improve its economy in the use of steam. For this reason I have given considerable attention to the subject, and take pleasure in now bringing to the notice of the society the "Economy test of a unique form of feed pump" recently conducted in England, in which the economy was quite remarkable compared with that of the ordinary type of steam pumps usually employed for feeding boilers.

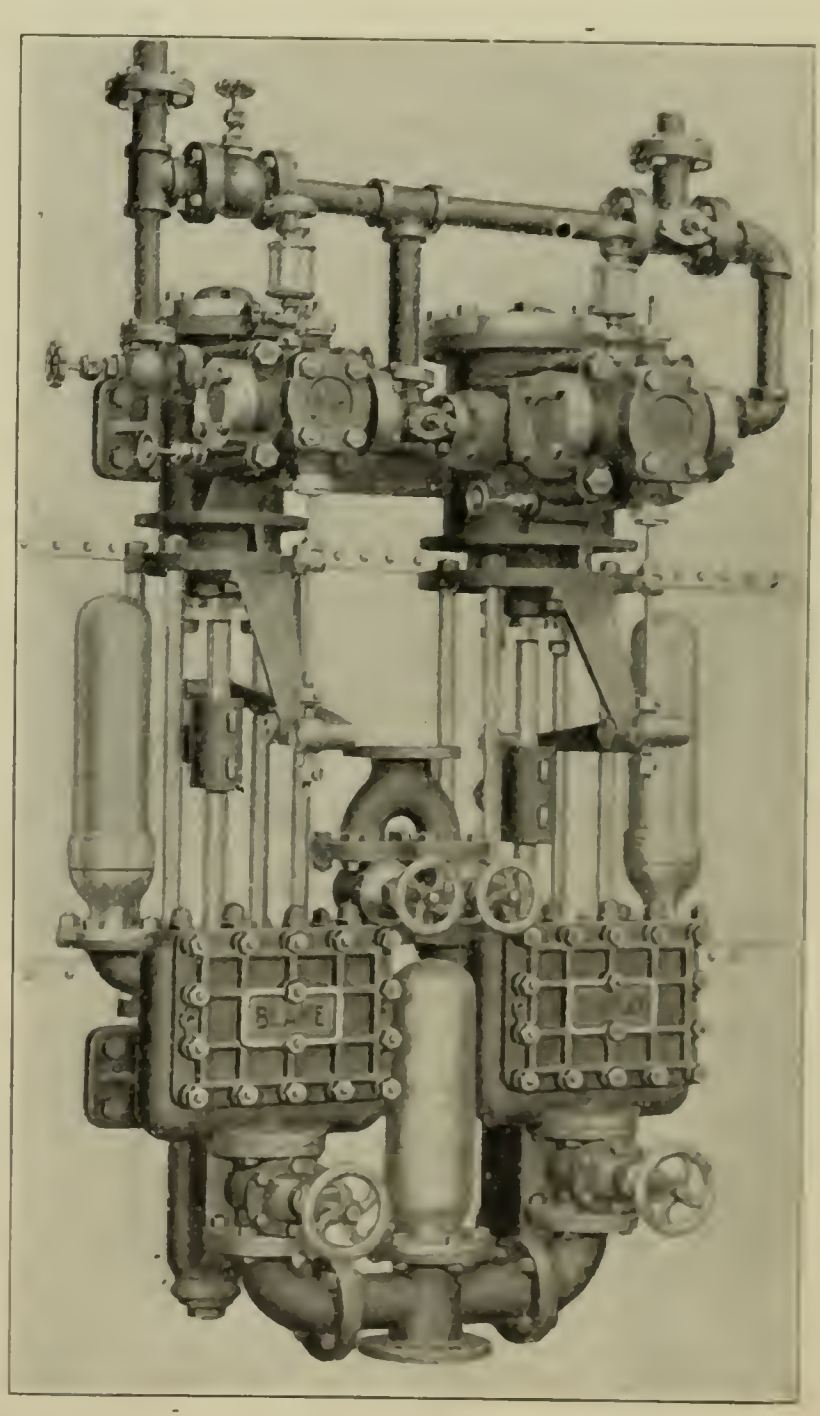
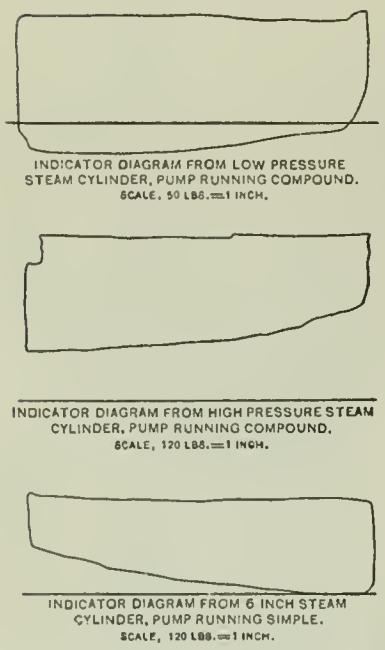


Fig. 1.

Now, it has been shown by tests that the steam consumption of a feed pump of the duplex type will average about 120 pounds weight of steam per I.H.P. per hour. In one test made the very best economy shown in the case of the main feed pumps was a little over 93 pounds, while the poorest showing (i.e., when one of the main feed pumps was supplying the donkey boiler, and consequently running at an abnormally low rate of speed), was over 200 pounds per I.H.P. per hour. The particular pump my paper refers to did its work with an expenditure

*Extracted from a paper read at the sixth general meeting of the Society of Naval Architects and Marine Engineers, New York, Nov. 1898.

of only 52 pounds of steam per I.H.P. per hour, which, considering the fact that it was quite a small unit, is a most excellent showing. In other words, this special form of pump uses considerably less than one-half the steam required ordinarily by a duplex pump of the simple type. The test referred to was conducted by experts connected with the engineering department of the well-known engine builders, Willans & Robinson, at their works at Rugby, England, and was for the benefit of the British Admiralty, who were represented by Mr. Antsey, the first assistant of the chief constructor of the Admiralty. There were also present Mr. Keighly, representing Thornycroft & Co.; Mr. Krohn, representing Yarrow & Co., and Mr. Hobbs, representing the Chester Engineering Co.; also Mr. Powel, representing the Blake & Knowles Steam Pump Works, of London. The feed pump tested consisted of a pair of Blake "Simplex" vertical double-acting steam pumps arranged on the cross-compound plan (see engraving of perspective view, figure 1), the high-pressure side having 6 in. diameter steam cylinder, 3½ in. diameter water cylinder, 8 in. stroke; and the low-pressure side having 9 in. diameter steam cylinder, 3½ in. diameter water cylinder, 8 in. stroke. The steam after being used in the



FIGS. 2, 3 & 4.

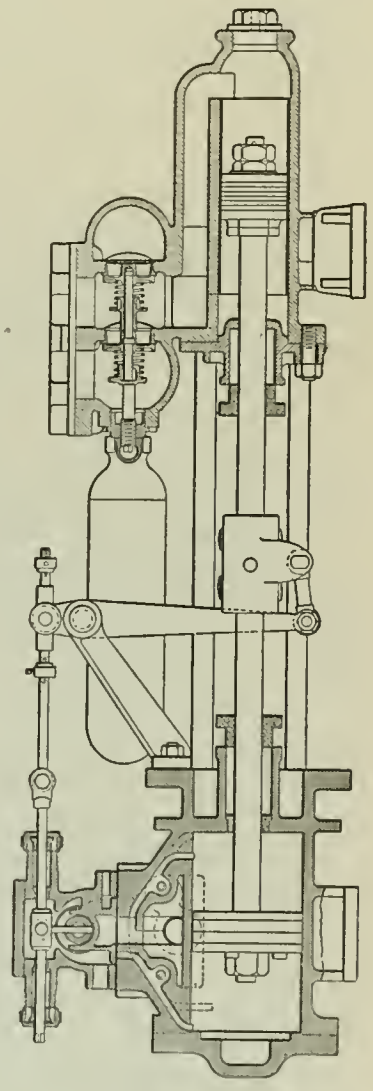


FIG. 5.

6 in. cylinder was expanded into the 9 in. cylinder; from the latter the exhaust steam was condensed and pumped to the weighing apparatus. Both water cylinders were connected to the one suction pipe having a length of 70 feet with five bends. The height of suction from level of the water in the supply well to the level of the discharge valves in the pump cylinders was 19 feet, to which should be added about 2 feet to represent the friction in the suction connections. The discharge of each pump led into a Y connection as shown, and the discharge pipe was provided with a gate valve sufficiently throttled to put on the pump cylinders a pressure of about 200 pounds per square inch—which, by the way, will be about the pressure these pumps are to feed against when installed in the torpedo-boat for which they were built.

I desire to call attention to an important feature of this arrangement of pumps in that it has all the advantages of the duplex system, so far as the continuous flow of the water is concerned, and yet either side can be run as a separate pump in case of accident to the other side. Then, again, the economy of compounding is secured with but two steam cylinders instead of four, as would be the case of a compound duplex pump. Therefore, there is less loss of steam from cylinder condensation; clearance is also reduced to a minimum, as the valve gear of one pump is not operated by the opposite pump, as in the duplex system; consequently, one side can make a full stroke without interference from the other side. The arrangement for testing (excepting the naked pipe that supplied the steam) was as complete and perfect as could be desired. For condensing the steam a surface condenser was employed with tubes having only screwed joints (Wheeler double-tube system), the same being tested to 200 pounds per square inch, so there was no suspicion of leakage. The condensed steam was carefully weighed in a perfectly balanced collecting tank. A small air pump was used simply for drawing off the water of condensation and discharging same to the weighing tanks, forming little or no vacuum. It was the intention of forming no vacuum in order to have this compound pump run under the usual conditions when exhausting into an auxiliary feed water heater—the latest and most economical method in use! The length of stroke could be accurately measured, as metal pointers were

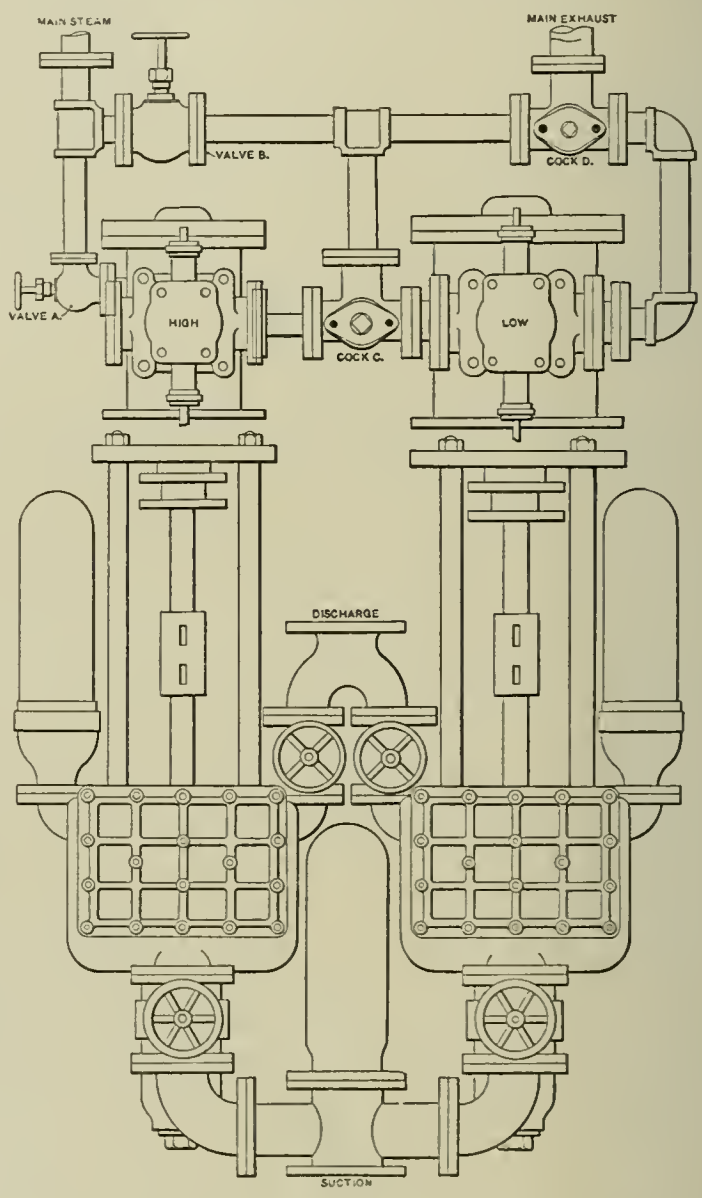


FIG. 6.

attached to the piston-rod crossheads. The length of stroke was easily regulated, as one of the special features of the "simplex" valve gear is the arrangement of the adjustable collars on the valve rods so that proper length of stroke can be obtained for all speeds, even when the pumps are in operation. The testing apparatus of Willans & Robinson's works is one of the most complete and perfectly arranged in Great Britain. The weighing of the water during the test was done automatically by electrically connected attachments, so that great accuracy was obtained and the time observations were taken to a fraction of a second.

Two tests were made—First, by running the pump compound; and, second, by shutting off entirely the low-pressure side and running the high-pressure side as a single pump. As mentioned above, the economy of the pumps when running compound was at the rate of 52 pounds weight of steam per I.H.P. per hour, while the economy of the pump running as a single pump was at the rate of 93.41 pounds per I.H.P. per hour. The former test is designated as "A" and the latter as "B," of which the following are the particulars:

TEST "A."—COMPOUND.

Duration of test	20.55 minutes.
Speed per minute, average for each side	40 double strokes.
Average length of strokes	8.06 inches.
Initial steam pressure per square inch	112.5 pounds.
Mean steam pressure per sq. in. high-press. cylinder	58.06 pounds.

Mean steam pressure per sq. in. low-press. cylinder	30.28 pounds.
Power developed by high-pressure cylinder	2.54 I.H.P.
Power developed by low pressure cylinder	3.07 I.H.P.
Total power developed by both steam cylind's	5.61 I.H.P.
Total weight of water collected	100 pounds.
Weight of water collected per hour	292 pounds.
Weight of water collected per I.H.P.per hour	52.04 pounds.

TEST "B."—SIMPLE.

Duration of test	28.35 minutes.
Speed per minute	54 double strokes.
Average length of stroke	8.05 inches.
Initial steam pressure per square inch	67.5 pounds.
Mean steam pressure per square inch	62.23 pounds.
Power developed	3.961 I.H.P.
Total weight of water collected	175 pounds.
Weight of water collected per hour	370 pounds.
Weight of water collected per I.H.P.per hour	93.41 pounds.

It will be noticed that these tests were of short duration, but they were amply long to demonstrate the economy of the pumps under the conditions given. The so-called system of "Flying test," in the opinion of the writer, is one of the best when the testing apparatus is electrically operated. Indicator diagrams, taken from the steam cylinders when running compound and simple, are herewith shown.

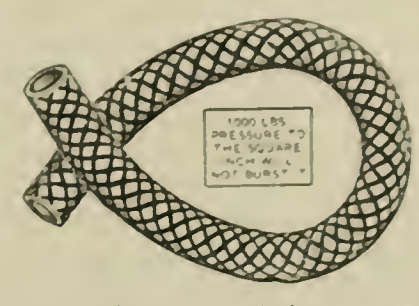
Figure 2 is the diagram from the high-pressure cylinder, and figure 3 the diagram from the low-pressure cylinder when the pumps were running compound; figure 4 shows the diagram from the pump running "Simple" (single pump). The steam-valve mechanism is very simple, and is shown by the sectional view of the pump; (see figure 5). It will be seen that the valve rod (so-called) has no valve directly attached to it as is usual; it merely rotates the auxiliary piston, which latter combines within itself the auxiliary valves. This rotating motion is claimed by the makers to be a great advantage, as it frees the auxiliary piston from possibility of sticking for any reason, causing the pump not only to be positive in its action, but securing uniformity of wear. The rolling movement given this auxiliary piston by means of the "valve rod" and the intermediate swinging pin or tongue, opens and closes the auxiliary ports, which, in turn, control the steam to operate the auxiliary piston, moving said piston back and forth across the main steam cylinder. A plain D slide valve is attached to this auxiliary piston, which valve supplies steam to the main cylinder through the two sets of ports, i.e., the main steam ports and the starting ports. By this cross arrangement of steam chest and valves, a "Simplex" pump can work, it is said, just as well vertically as horizontally.

As regards the amount of steam that can be saved by this system the makers claim that there is no doubt but what the pump will save its own weight in coal in 24 hours' steaming. As an illustration, they state this particular pair of pumps with the attachments weigh about half a ton, and handled during the test at the rate of 17,570 pounds of feed water per hour. Now, this amount of water would supply the boilers necessary to operate a marine engine of the triple expansion type of about 1,100 h.p. The power of the pump as noted in the compound test was 5.61 I.H.P., or about one-half of one per cent. of the power of the engine above given. On the basis of a saving of, say, 70 pounds weight of steam per I.H.P. per hour over and above what would be ordinarily used by a duplex pump of the simple type, it shows a total saving of steam (feed water) of about 393 pounds per hour, or, say, 50 pounds of coal per hour, on a basis of about 8 pounds of water per pound of coal, for the rate of boiler evaporation. This gives a total saving of 1,200 pounds of coal per 24 hours, which, it will be observed, is somewhat more than the weight of the pump, so that I am rather understating than overstating the case. Or, as compared with the single system of feed pump, the cross-compound "Simplex" would save its weight in coal in forty (40) hours. With larger size pumps, and with steam pipes covered, the economy of the "Simplex" compound would be even better than that shown in these tests.

The Mispec, N.B., pulp mill will, it is expected, be in operation by April 1st.

METALLIC FLEXIBLE TUBING.

This illustration shows an article new in the Canadian market and one of great merit. Metallic flexible tubing is devised for the armoring or re-enforcing of rubber hose where great resistant power coupled with flexibility is required. The old method of attaining that end was the using of the best grades of rubber hose of heavy weight, and having it strongly wired. By the use of this new armor, which can be put on the hose by any ordinary mechanic, a three-ply hose is made to withstand the highest steam, hydraulic or compressed air pressure used. It is then claimed to have the durability of steel with the flexibility of rubber hose, and can be made to withstand 5,000 pounds pressure to the square inch. It prevents bursting, kinking and mashing of the hose, and being smooth on the surface is easily drawn over rough ground. Besides being used for hose protection it is adapted for armoring electric cables, protecting the outer insulation and materially increasing the tensile strength where cables are suspended. This tubing can be applied to the inside as well as to the outside, when desired for suction hose. The value does not only consist in the safety feature, but is claimed to be an economizer on rubber hose expense to the extent of 80 per cent., besides preventing loss of time, and guarding against accidents so often caused by bursting hose. It is made of fine, tempered, flat steel wire, galvanized, and as it is made in long lengths, can be cut as desired. Samples for testing purposes, price list and discounts may be obtained from the Canadian agents, Darling Bros., Reliance Works, Montreal.



THE MONTREAL, OTTAWA AND GEORGIAN BAY CANAL.

The subject of the Ottawa Valley route for western traffic to Montreal was discussed at the recent meeting of the Canadian Society of Civil Engineers in a long and comprehensive paper by Henry K. Wicksteed, Mem. Can. Soc. C.E. As The Canadian Engineer has already taken up this subject somewhat extensively, it is not necessary to reproduce the whole of Mr. Wicksteed's paper, but merely summarize some of the leading arguments which we have not before taken up so fully. The claims of the route as a natural trade outlet are strongly urged and the question of strategic value is also gone into. When Mr. Wicksteed was a boy, brigades of Northwest canoes still started from Lachine, ascended the Ottawa, skirted the North shore of Lakes Huron and Superior, and then made their way through the labyrinth of lakes and rivers between the latter and Lake Winnipeg. Coming down to modern times, the Ottawa Valley was accepted without question as the route for the Canadian Pacific Railway. But the settlement and rapidly growing wealth of the southern portion of Ontario fronting on the two lower lakes, the comparative non-progress of the central plains west of the Red River, and the demands of local trade, led to the construction of the Welland and the Rideau canals, and later of those on the St. Lawrence itself. And although, in 1858, the Ottawa river was examined with a view to further extension of canal navigation, and favorably reported upon, it was deemed that the times were not ripe. Still later, and bearing directly upon the question at issue, is the completion of the Ottawa, Arnprior and Parry Sound Railway and the enormous traffic developed by it. Showing that, in spite of "vested interests" and "established trade routes," trade is eager to avoid the long circuit of the St. Clair river and flats, and the dangers and difficulties of navigating them, and of the Detroit river and its mouth.

The Ottawa river is in its lower stretches below the city of Ottawa, a series of broad shallow stretches, flowing over flat limestone rocks belonging to the lower Silurian group. Almost immediately above Ottawa it loses this character, and becomes

a Laurentian river, consisting of a number of deep, almost currentless pools, separated or connected by short abrupt falls and rapids tumbling over the hardest of solid rock. The same applies to the Mattawan, and, in an even greater degree, to the French river. The navigable reaches now existing are almost ideal ones, it is stated, with scarcely any improvement, deep and broad enough to admit of high rates of speed with vessels of considerable draught and magnitude. The one important exception to the prevalence of hard granitic or syenitic rocks at the salient points is that of the summit or divide between Trout Lake on the Mattawan and Lake Nipissing, which is largely, if not wholly, composed of drift, the summit being only three feet above Trout Lake and 27 feet above Lake Nipissing. In view of the moderate depth, this is probably the one point at which he would prefer sand cutting to solid rock, as the two lakes would be brought to the same level, and this somewhere near the present high-water level of Nipissing. In connection with the water supply about which some doubt has been expressed, owing probably to a misapprehension of the meaning of a clause in Mr. Shanly's report of 1858, Mr. Wicksteed states, that Mr. Shanly and Mr. Clarke both describe the supply of Lake Nipissing as being inexhaustible, and Mr. Clarke goes into more details, and says: "The quantity of water flowing from Lake Nipissing at a low stage was found by careful gauging to be 9,500 cubic feet per second," or 820,800,000 cubic feet per 24 hours, to which must be added the volume of the Mattawan. And he further remarks that this is equivalent to 5,472 lockages of 250x50x12 in each 24 hours. And, finally, "this sets at once at rest any idea of the necessity for a storage reservoir."

It is suggested by the author that in view of the fact that alternate channels exist in many cases, as in almost the whole of the French River, it would be quite possible, and he believes in a majority of instances much cheaper, to use the bed of the river itself for the lock chamber and allow the surplus flow to find its way through the other channels. Downwards through the Mattawan and its lakes and the Ottawa and its expansions to the foot of Deep River the topography is almost constant in its character, and the methods of dealing with obstructions the same throughout. Controlling dams to retain the levels as nearly as may be the same at all stages of the water and short canals with locks at various points. The narrowness of the canyon and the rocky nature of its walls would, it is thought, make it peculiarly easy to drown out minor differences of level and to concentrate the fall within a short distance. Below the Deep River the Ottawa expands into the Allumette Lake, the improvable channel lying to the north of the Allumette Islands by the Culbute channel. Lower down is the Coulonge Lake, and below this the Portage du Fort, embracing a series of rapids and falls extending to the town of that name, giving an aggregate fall of 98 feet in a distance of 10 miles, the most rapid pitch found on any part of the river below Mattawan. The methods of dealing with these falls is the same as for others, drowning out the smaller ones by means of dams, and connecting the pools so formed by short canals and locks. As in the case of the French River, the existence of parallel channels render the improvements easier of accomplishment than they would otherwise be. Below Portage du Fort comes Chats Lake, 18 miles in length, and with the exception of a couple of minor obstructions of good depth (not less than 25 feet) throughout. At the foot of Chats Lake are the Chats Falls, 50 feet fall in 3 miles. Here again the river is divided by islands into many channels, and the same methods of construction are available with a total length of canal only 6-10 of a mile. The river then enters Lac des Chenes, 26½ miles long, with a general depth of from 20 to 30 feet with some few short bars covered by less water, and is now clear of the Laurentian rocks, and the river enters a limestone country which continues to its mouth. Below Lac des Chenes the river drops 60 feet in a distance of 6½ miles. At Ottawa city very considerable works will be necessary, but below the city the present navigation for light draught vessels already exists, and has been treated of before in these columns. It is suggested that the canal should reach Montreal by the Back River, thus creating very valuable water power. A hint of possible developments in power is given in the statement that the low water flow of the Ottawa at Mattawa is 25,000 cubic feet per second; its elevation at that point is 500 feet above the sea. Without counting on tributaries and increase of volume, this represents a total horsepower of 1 1-3 millions, or, reckoning on a 10-hour instead of a 24-hour day, of over 3 millions. Mr. Wicksteed concludes his paper by again calling attention to the breadth and scope of the project, and that it is not a matter of local development or even of the advancement of the Dominion of Canada. It concerns the Empire and the neighboring Republic, and will affect rates and prices over at least one-half of the North American continent. It is not a competitor in any sense with the railways, for it will, as Sir William Van Horne has said, bring them more traffic than it will take away. As we have seen in the case of the Sault Ste. Marie lock, a large portion, if not the major portion, of its traffic will be of its own creation, and of such a nature as could not exist without it.

SERIES ARC LIGHTING.*

BY W. H. TURBAYNE, E.E.

Although the arc light first made its appearance about the beginning of the present century, it is only within the last quarter of a century that it has become generally adopted as an illuminant. About the year 1802 an Englishman, Sir Humphrey Davy, conceived the idea of opening an active electric circuit between two points of carbon. He had at his disposal some 2,000 cells of a simple primary battery, which he connected in series, and from the extreme terminals he brought wires to the ends of which were connected small pieces of charcoal. These he touched together and afterwards drew apart, and in so doing the current bridged the gap which was made, appearing as a flame having powerful heating properties and causing the charcoal tips to glow to an intense whiteness. Thus appeared the first true arc light.

The charcoal points were evidently held in a horizontal position as the stream of vaporized carbon appeared in the form of an "arch," being impelled upwards in the centre by the ascending currents of air; from this phenomenon we derive the name "arc" light. About thirty years after this discovery of Davy's, Michael Farady discovered and promulgated the principle of electric-magnetic induction. He found that when a steel bar magnet was passed through a coil of wire, properly arranged, a current of electricity was momentarily induced in the coil, which manifested itself similarly as the current from a primary battery, and this important discovery soon led to the development of the dynamo machine for producing powerful currents. Previous to the introduction of these dynamos the arc light was seldom seen outside the laboratory, the expense and annoyance, coupled with the use of acid batteries prohibiting its most extended adoption. With the advent of the dynamo renewed interest was taken in the development of the arc light. Mechanisms called lamps were devised for feeding the carbons together as they wasted away and improvements were introduced into the current generators so that an uninterrupted light could be maintained for considerable periods. Even at this time, however, the usefulness of the new light was limited, as it was found that the feeding of the lamp so affected the current in the line that only one lamp could be operated on a single circuit, and that it was only in certain isolated cases, such as in light-houses, that the light became of value. This was the condition of affairs until some forty years later, when in 1875 Chas. F. Brush, of Cleveland, U.S.A., and others discovered the principle of differential regulation, which made the operation of several lamps on one circuit and machine possible, and made each lamp an independent unit as regards its feeding properties.

It is not our intention in this paper to follow the art of arc lighting from the date of its inception, and to successively note the advances which have been made in bringing this method of illumination up to its present state, but to offer a brief exposition of the cardinal principles involved, and to shortly describe the functions of the mechanisms employed in a modern system of series arc lighting, in which a direct current of constant value is employed, a system which has been developed since the introduction of the differential lamp of 1875. Such a system virtually comprises a current generator or dynamo, a number of arc lamps and an arrangement of conductors interconnecting the whole in such a manner that the current on leaving the

*A paper read before C. A. S. E., Hamilton, No. 2.

dynamo enters the first lamp and thence passes to the next, and after having successively traversed all the lamps in like order returns to the dynamo, the path of the current therefore being in one continuous circuit within which the total electrical energy produced by the generator is expended. If we take a pair of carbon rods and introduce them into an active electric circuit as above, no light will be emitted until a separation of the carbons takes place, and we find that, with the current strengths adopted in practice, a separation of approximately one-eighth of an inch gives the best results as being free from objectionable hissing or flaming. Such an arc requires for its maintenance an electro-motive force or pressure of about 45 volts, which represents an energy of something over ½ h.p. This energy is expended, in part, in overcoming the resistance of the arc gap, but the greater part appears in the form of heat and the resulting temperature is so concentrated and intense as to cause a vaporization at the surface of the positive carbon, which in the process is brought up to a highly incandescent state, this being in reality the source of light. This vaporization and a combustion of the carbons is accompanied by a gradual wasting away and consequent shortening of same, and in order, therefore, to maintain an uninterrupted light means must be found for feeding the carbons together at a rate proportional to this consumption.

An arc light, therefore, is substantially a mechanism for initially separating the carbons a predetermined distance during continued operation. In studying the arc lamp we will not touch on the innumerable mechanical devices, such as racks and pinions, brake wheels, clutches and bands or chains, which are employed with the one view of gripping and releasing the carbon under the control of the actuating magnets, but we will describe the action of an ideal differential lamp, such, in fact, as may be taken as a representative of the types in extended use. The carbons are separated by an electro-magnet in the main circuit through which the whole current passes, while the feeding is effected by another electro-magnet acting in opposition to and tending to overcome the lifting action of the first. The second magnet is provided with a high resistance winding of fine wire and is connected as a shunt across the carbons, and therefore exerts a greater or lesser influence, accordingly as the carbons are more or less widely separated. Therefore as the carbons are consumed the arc increases in length and coincidently the second magnet opposes the action of the first until finally it overpowers it and allows the carbons to feed forward. In practice so fine a balance is obtained between these two magnets that the carbons are continually feeding forward in imperceptible degrees.

There are, of course, numerous modifications of this principle introduced into different lamps, but, nevertheless, their electrical actions are similar, inasmuch as the separation of the carbons is brought about by the action of the main current itself, while the feeding is accomplished by the action of the circuit derived from this and having as terminals the upper and lower carbons. We may here state that the illuminating power of an arc lamp varies with the electrical power which is expended within it. This electrical power, expressed in watts, is the product of two factors, the electro-motive force or pressure, and volume of current as expressed in the terms volts and amperes respectively. We have seen that the function of the arc lamp is to look after one factor, viz., the pressure or volts across the terminals, consequently in order to produce an unvarying light we must keep the other factor of current volume constant.

The function, therefore, of the generator or dynamo is to furnish a current of constant strength, and, as the lamps are connected in series, and as each demands some 45 volts as explained, it must operate at a pressure sufficient to maintain the number of lamps for which it was designed to operate, together with sufficient marginal pressure to overcome the resistance of the copper lines connecting same. An arc lighting dynamo, like most other dynamos, consists essentially of an arrangement of copper conductors wound over an iron core and rotating within the influence of the poles of a powerful electro-magnet, but, as contrasted with constant pressure dynamos, which include those used in operating incandescent lamps in multiple and those used in furnishing current to stationary and street railway motors, it must possess peculiar properties, which are required to adapt it to the running of arc lamps on series, and notable among which is that a fall of current below the normal strength must be accompanied instantly by a rise in voltage and likewise with an increase of current the voltage must fall. We may here state that while the function of a constant pressure dynamo is to keep the electro-motive force or pressure factor constant, while the current is variable, the constant current or arc dynamo, on the other hand, must keep the current factor constant while the pressure is variable.

In such a machine the magnets are series wound, and the energizing windings are traversed by the full current passing through the circuit of lamps. The iron magnet cores are so proportioned as to be magnetically saturated, that is, are worked to such a high degree of magnetization as to be insensible to slight changes in the strength of the current which energizes them. On the other hand the rotating armature is wound with a number of turns of wire and in reality constitutes a powerful magnet, which is sensitive to current changes, and which meanwhile reacts against and partially controls the magnetic field, which induces the current within itself. As therefore the switching off of a lamp, or the feeding of several lamps at once, would cause the current to rise, the armature magnetization would increase perceptibly, while that of the field magnet would not do so, the former would, therefore, so react against the latter as to reduce the effective magnetic strength and the voltage therefore would fall; the reverse action would likewise take place should one or more lamps be switched on.

In order that this inherent regulating property will be effective over the whole range of the machine, automatic current regulators are employed, which by moving the collecting brushes around the commutator, or by adjusting the field strength, so adjust the electro-motive force and incidentally the current strength as to meet the conditions of the outside load and further assures sparkless operation at the collecting brushes. The power required to drive an arc dynamo will be in proportion to the number of lamps burning at any time, and will vary as the number of lamps in operation. As we have stated that the electric power is the product of the current volume and the electro-motive force, and as the former factor is constant the power delivered will vary, therefore, as the latter factor, which varies only as lamps are added to or withdrawn from the circuit. Arc dynamos, unlike constant pressure dynamos, do not necessarily demand the refinements in speed governing in the movement which drives them, as the inherent regulation of the machine itself will look after any such irregularities as are met with in practice and in fact, with the brushes locked in a fixed position, constancy of current during change of load may be obtained by varying the running speed only. There are other accessories such as automatic lamp cut-outs, which ensure continuity of the circuit should a lamp be defective; lightning arresters for protecting the lines and station apparatus; and loop switches for controlling groups of lamps, which we cannot now cover in detail and which, although essential to the satisfactory and safe operation of such a system, yet are not necessary to the production of the light itself, the generator and lamps being the indispensable adjuncts of a series arc lighting system.

THE PRACTICAL MAN.

Improvement in the Manufacture of Steel Wool.—There is now an established demand for steel wool, and its manufacture is in successful operation. The process by which it has heretofore been produced consisted in clamping together a number of circular disks of thin sheet steel, slowly revolving them, and then with a sharp-edged flat tool taking off thin shavings from the edges of the disks until they were all converted into "wool." The improved process, lately patented, consists in winding a long sheet of thin sheet steel into a tight roll, and then using a flat cutter to shave the "wool" from the end of the roll. This latter process is evidently the cheaper, involving both less labor and less waste of material.

Rubber Packing.—Where rubber packing is used, it will last many times longer and not blow out, if a piece of common wire screen (same as used in window screens), is put on each side of the rubber. It embeds itself in the rubber and holds it together, so that when hot and soft, it cannot blow out.

Case Harden Cast-Iron.—Heat to a red heat, roll in a composition consisting of equal parts of prussiate of potash, sal ammoniac, and saltpetre, pulverized and thoroughly mixed. Plunge while yet hot into a bath containing 2 ounces of prussiate

of potash and 4 ounces of sal ammoniac to each gallon of cold water.

Tempering Liquid.—Water, 3 gals., salt, 2 qts., sal ammoniac and saltpetre, of each 2 oz., ashes from white ash bark, 1 shovel full. The ashes cause the steel to scale white and smooth as silver. Do not hammer too cold. To avoid flaws, do not heat too high, which opens the pores of the steel. If heated carefully you will get hardness, toughness, and the finest quality.

To Weld Cast-Iron.—Take of good clean white sand, 3 parts; refined solution fosterine and rock salt of each 1 part; heat the pieces to be welded in a moderate charcoal fire, occasionally taking out and dipping into the composition, until they are of a proper heat to weld. Then lay at once on the anvil and gently hammer together. If done carefully by one who understands welding iron, they will be nicely welded.

Bluing.—Ten lbs. saltpetre, 1 lb. black oxide of manganese. Heat (in a crucible) to a point that will ignite pine sawdust, stir thoroughly. Suspend work in a wire basket (keeping basket in motion), until proper color is obtained.

In laying out work on planed surfaces of steel or iron use blue vitriol and water on the surface. This will copper-over the surface nicely, so that all lines will show plainly. If on oily surfaces, add a little oil of vitriol; this will eat the oil off and leave a nicely coppered surface.

Put a piece of resin the size of a walnut, into your babbit; stir thoroughly, then skim. It makes poor babbit run better, and improves it. Babbit heated just hot enough to light a pine stick, will run in places with the resin in, where without it, it would not. It is also claimed that resin will prevent blowing when pouring in damp boxes.

To make a tap or reamer cut larger than itself.—Put a piece of waste in one flute, enough to crowd it over and cut out on one side only. In large sizes (½-inch or over) put a strip of tin on one side and let it follow the tap through. You will be surprised at the result.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.

A meeting of the executive committee of the Fire and Police Telegraph Superintendents' Association was held in Boston on January 28. The object of the meeting was to revise and amend the constitution and by-laws in accordance with the resolution passed at the third annual convention at Elmira, N.Y., and to outline the arrangements for the next annual meeting which takes place at Wilmington, Del., September 5 and 6, also to suggest topics for papers to be presented at that meeting. It was decided to change the name from the International Association of Fire and Police Telegraph Superintendents to the National Association of Municipal Electricians, which title renders eligible for membership all officials engaged in the electrical departments of municipalities throughout America, instead of only those engaged in the fire and police telegraph departments as heretofore. The associate members are composed of manufacturers and dealers in apparatus and appliances relating to the interests kindred to the association.

SOME METHODS OF SEWAGE DISPOSALS.

BY W. M. WATSON, TORONTO.

For THE CANADIAN ENGINEER.

In an article on sewage in the October issue of The Canadian Engineer reference was made to the sewage purification systems invented by the late Geo. E. Waring and Jerome Deery, the latter system being the one adopted at Reading, Pa., U.S.A. As the writer did not fully describe the processes it may be interesting to explain the methods employed. The Deery's system is divided into two parts. First, the screening or sieving process, and afterwards the filtering. The raw sewage of the town is led from the central outfall into a tank made circular, or any shape or size suitable to do the necessary work. About two feet from the concrete floor there is a permanent fine grating fixed that fills the whole tank space; on the top of this grate cinders, coke or the breeze of coke is spread to a thickness of over 8 inches. Then on top of the coke there is another fine grating laid on light girders. A little above the top grating one or more half round troughs are carried across the tank, whose top edges are turned over like the rolled edges of a cast-iron bath, and the sewage is brought to the screen from the sewer by way of these troughs, and overflows over both edges in a very thin stream, dropping on the fine iron grating, which retains the floating matter, while the heavy solids remain in the bottom of the half round or D shaped trough; it then worms its way downward through the bed of coke, and drops through the lower grate to the concrete floor, where it is collected and sent to the filters in pipes.

Each tank is carefully enclosed over the top of the troughs, which forms an air space between the top cover and the face of the upper grating, and between the lower grate and the floor. This open space is used to aerate the sewage as it is falling from the troughs to the upper grate, and as it drops from the lower grate to the floor. The atmosphere is introduced into the two spaces by air passages extending from one side of the tank to outside the building—they are like the air chutes serving a hot air furnace—and on the opposite side of the tank there are corresponding air flues extending to an annular hot-air flue constructed in the long chimney that serves the steam boiler. The smoke and heat pass up the centre of the chimney through the interior of an iron tube or tile pipe, and all around this iron tube there is arranged a wide space, i.e., an annular flue, which attracts a large amount of heat from the central smoke tube, and the heat causes a keen draught; thus all the sieving tanks have a strong current of fresh air continuously passing both under and over the bed of screening coke, with the object of aerating and supplying oxygen to the sewage as it is distributed on to the upper grate, and when it is discharged from the lower grate to the floor. After aerating the sewage the air passes onward and upward through the annular flue of the chimney to the outside.

The coke sieves soon become choked with dirt and fat contained in the sewage, and when necessary the troughs and upper grating are removed, then the wet, dirty coke is taken out and conveyed to a brick vault having a graded floor, over which a false floor is constructed of iron pipe or bars covered with fine wire netting; on this floor the wet coke rests. All round the vault walls are covered with 1-inch steam heating pipes, and there is a flue to convey the vapor to the annular flue of the chimney. When all the dirty coke is removed from the sieving tank to the drying vault the doors of the vault are closed, and high pressure steam from the boiler is passed into the interior pipes, which quickly heats up the coke; the fat melts and dropping to the floor is afterwards collected, placed in barrels, and disposed of. The wet is evaporated and passes up the chimney, and the dirt is dried into fine dust, and afterwards (the inventor informs us), the coke can be re-used for sieving purposes, or used for fuel to generate steam, and in this way the inventor gets rid of the sludge difficulty, which in many other processes is very troublesome. This is certainly a better method than using pumps and sludge presses, though it will be expensive; but the expense might be reduced considerably by dropping the aerating features and all the appliances used for that purpose, because it is of no advantage to aerate sewage during the time it is passing through the sieve and getting screened, in fact, experience has proven that if both air and light are excluded at that time better results are obtainable.

We now come to the filtering process. The filters are built on two flats; one set of filters is constructed immediately over the other, having an air space of over 8 feet between the top of the floor filters and the underside of the elevated filters, which are built on pillars and cross girders, and the reservoirs or filter tanks are constructed in sizes suitable for being easily cleaned or repaired. The sewage from the sieving tanks is conveyed in pipes resting on standards fastened to the tank partitions, and from the pipes the sewage flows over D shaped troughs carried across the surface of the filter—one trough about every 2 or 3 feet—in such a way that the sewage falls on the filtrate evenly and in thin films, thus securing another aeration before entering the bacteria filter, which should kill any putrefactive bacteria that may be left in the sewage. Whether this is any advantage or not I will leave others to judge, but we know that the putrefactive bacteria is food for the purifying bacteria, and on that ground the filter seems to be the place where they ought to be destroyed. The bottom of the higher flat of filters is fine open grating on which the filtering material rests, and as the sieved sewage passes downward through the

filtrate it drops out through the porous grating and falls on top of the filtering material contained in the floor filters, in drops, or fine spray, and in this way the fluid is expected to secure another good airing. Under the filtering material of the lower or floor filters there is a net work of tile pipes graded in sections, in a way that the highest point of each branch terminates in the centre of each filter tank, and all the branches draining each filter are connected to a ventilating tube, extending from the head of the combined drains, upward, through the centre to about two feet above the surface of the filtering medium. The object of this is to draw away the light gases and introduce the heavier oxygen to the underside of the filtering material, and to ensure this being done all the drain pipes are perforated with numerous holes, and the discharge ends terminate into a large open culvert from which any amount of atmospheric air may be drawn. Filters built one over another, with open air spaces between each other, were used in England several years since, and found of no advantage whatever; because the only agents that properly purify sewage and prevent it ever after setting up putrefaction, are the reducing bacteria, and the exposure of the sewage for a sufficient length of time (not less than 30 minutes), to the action of the oxidizing organisms that have a proper resting place made in a way that every particle of fluid is compelled to pass in front of the microbes, which are so small that Dr. Richards has proved that it takes a billion and a quarter to weigh one grain. This bacteria workshop is named a filter, and the filter, like every other healthy workshop, must be well and properly aerated to supply the organisms with at least three times the bulk of air to one of sewage, or perfect purification must not be expected. Therefore, if any person gives his whole energy to aerating the fluid sewage itself, and ignores the value of aerating the filter or microbe workshop, he cannot discharge a purified effluent of sufficient purity to be safe, and the discharge from his works will probably afterwards set up putrefaction that will undo any work previously done. The writer of the October article states that 1,143 gallons of sewage is passed through each square yard of filter space per day. In that case then the filters are not bacteria filters, but simply sieves that fine the fluid and extract the solids, but cannot purify the sewage. First, because bacteria could not hold their position in a filter having such a rapid stream passing through it, and if ever any of the microbes should secure a lodgment in the filtrate material they would be washed out and forced along with the stream, Second, even were it possible that such filters could be charged full of purifying bacteria they would not have sufficient time allowed, with such a rapid stream rushing through them to do much, if any good work.

It is almost idle to expect that more than about 200 gallons per yard per day of 24 hours' continual working, can be well purified by the microbes, even when properly housed in a well arranged filter composed of ⅜-inch or ½-inch cubes of coal, clinker, coke, gravel or other hard material, and when the oxygen is introduced by mechanical appliances regularly and evenly throughout all the intersections of the filtrate material. So that the system will need a filtering area about six times larger than described to ensure an effluent that will be properly purified in a way that it cannot afterwards set up putrefaction and nullify the work previously done. This is the opinion of experienced experts, and will also be shown by the description of Col. Waring's system hereafter described.

Geo. E. Waring's system consists of cleaning sewage by purifying bacteria, and is quite different to such methods as Cameron's, of disintegrating and fermenting the sewage, to split it up into particles and let free the gases in a primary settling tank, using the anaerobic microbes for the purpose, before the sewage is sent to the bacteria filters to be purified by the aerobic or purifying microbes. It is also different to Lomax's process of intermediate flushing, practised at Chorley, Eng., by the International Sewage Purification Co., of London, Eng., which was fully explained in several of the back numbers of this paper, and to a committee of the Toronto and London city council early in the present year, and again dwelt upon on page 221 of the December number.

The Waring system, and also the Deery system, does away with the very expensive practice of collecting, pumping and pressing the sludge, for they each destroy it; nor do they follow the Chorley example of using expensive precipitants, a method which is fast dying out, and is only necessary where the sewage has a large amount of tenacious chemicals in it, which is seldom or never in Canada. Col. Waring uses mechanical appliances to force air into the filter, and between all the interstices of the small cubes stored in the filter, continuously, and by so doing he supplies the bacteria housed in the filter with all the oxygen they require, without stopping the flow of sewage on to the filter to be aerated, as is done by the Lomax system of intermediate flushing, and then stopping the flow, and allowing the filter to stand idle for a period. On this ground it is held by the inventors of the forced draught or continuously aerating system that double the work can be accomplished than can be done by the Lomax intermediate system.

This mechanical method of aerating sewage filters was first invented and patented by Sidney R. Lowcock, 35 Waterloo street, Birmingham, Eng., about 1897, and lately taken hold of, and, I believe, patented in the United States by the late Col. Geo. E. Waring, jr. The way Mr. Waring applies the process is very ingenious and worth studying, for he very properly avoids showy and expensive arrangements and appliances; he also studies to assist nature to do the work rather than copy the example of many engineers, who put expensive obstacles in the way of the little bacteria doing the work they were created and appointed to do. Therefore, the process can claim to be a natural system, which cannot be said of others that have been described. He first collects the raw sewage into an elevated tank, and from this tank the sewage flows by gravitation through pipes to each roughing filter, which sieves the sewage, and at the same time gives ample time for the anaerobic bacteria to do their part of the work of cleansing the sewage before being totally destroyed themselves. These roughing filter tanks are in two divisions, divided by a light partition into two halves, which extends from the top to about 6 inches from the bottom. At this point there is a false bottom of grating or bars on which about 3 or 4 feet in thickness of coke is placed, and the sewage passes downward through the coke on one side of the middle partition, then bends under the bottom edge of the partition, ascending through the coke of the other half of the tank, afterwards overflows in a thin film over the lip constructed on the side of the tank, where it receives some aeration, then it is distributed by suitable channels, evenly over the surface of the filters.

These roughing filters like Deery's sieves get clogged with dirt and fat until the sewage refuses to pass through the coke, then the sewage is turned on to another pair of roughing filters, and the sewage remaining in the tank is drained out of the clogged coke by an outlet at the bottom, and when quite empty a strong current of air is forced into the vacant space between the concrete and the false grated bottom, and is gradually forced upward through the interstices between the particles of coke, which in time supplies oxygen necessary to start bacterial activity, and oxidization at once begins, and the accumulated filth and fat is destroyed by the purifying organism (so Col. Waring assures us), and in this way he gets rid of all the sludge extracted from the sewage at a trifling expense of running a fan by electricity. This is a big step in advance of using precipitants and sludge presses. The filters are filled about 3 or 4 feet thick with small crushed and sieved coke, covered about 2 inches thick with clean, fine sand to prevent the sewage from entering the coke in the filter quicker than the bacteria can purify it, so in reality the sand is made to act as the regulating valve, to measure and distribute the sewage in needed quantities to the bacteria lodging in the cells of the coke filtrate below.

Underneath the coke there are placed perforated tile pipes on the fish bone plan, which do double duty, for they collect the effluent falling from the coke filter and convey it through an interception trap (which is here necessary to prevent the escape of air that is discharged by the fans to the filtering material) to the culvert carrying the effluent away, and they also form the carrying flues to distribute the air from the fan to the underside of the filtrate, and it is distributed at a pressure sufficient to force its way upward through the intersections of the 3 or 4 feet of small coke and the 2 inch blanket of sand, efficiently removing all the hydrogen generated by the bacteria, and supplies them with plenty of oxygen to maintain their constant activity. Thus when the filter has got filled with the purifying bacteria it needs only to have the sewage carefully and slowly distributed evenly over the surface, and wind at a proper pressure continuously forced up through the filtering material, from

the bottom; and it will continue to work forever, without any cleaning, raking or disturbing in any way, but stop the wind for a short time or increase the flow of sewage to 1,100 gallons per yard a day, and out will go the valuable bacteria with the rapid stream, and the filter will be worthless until another set of bacteria is bred and installed, which would take at least two months.

The value of a filter well stocked with the purifying bacteria is very great, and needs careful handling, therefore every appliance must be duplicated and constantly watched, so that should any accident or stoppage occur, another set can be at once started to take the place of the disabled apparatus, and prevent the life of the microbes from being jeopardized. There are simpler methods than either of the three above described that have worked for years giving a fairly pure effluent, but their simplicity prevents them being noticed, for people looking for such sewage purifying systems look for something large and intricate, requiring a number of hands. The one at Chorley is among the most expensive ones, both in plant and management.

DEGREES IN SCIENCE AT MCGILL UNIVERSITY.

The Corporation of McGill University has decided to grant the degree of B.Sc. (Bachelor of Science) in the faculties of arts and of applied science. Candidates for this degree in the faculty of arts must pass a matriculation examination in English, with history; another language, mathematics, and either physics, chemistry, botany, physiography, an additional language and additional mathematics. In the faculty of applied science additional mathematics (including trigonometry) must be taken at matriculation, and the above options are not allowed. These regulations apply only to the examinations for this and next year. In 1901 another language will be required in both sections, with the option of elementary science in the applied science faculty; and it is hoped by that time the matriculation examinations in both faculties will be placed on the same footing. Candidates for the B.Sc. in the faculty of arts who intend to take medicine must take Latin as one of their subjects at matriculation. A board of matriculation examiners was appointed to control the matriculation examinations in the various faculties, and assimilate the conditions. The B.A. Sc. degree (Bachelor of Applied Science) is changed to B.Sc. Graduates who have taken the former degree may retain that title or drop the word "applied," at their choice.

The B.Sc. students in the faculty of arts will take the following course: First year, English, French, German, mathematics and physics. Second year, English, logic, French, German, chemistry and mathematics or botany or zoology. In the third and fourth year the B.Sc. student will specialize in selected groups of the following subjects: Mathematics, physics, astronomy, chemistry, zoology, botany, geology, physiology, human anatomy. In the B.Sc. diplomas the word (arts) or (applied science) will appear in the diploma to indicate the faculty in which the candidate has prepared for his degree. The M.Sc. will be granted to Bachelors of Science in both faculties, and to Bachelors of Arts of (a) at least one year's standing, provided that they have for one year taken a graduate course of study in science, previously submitted to and approved by the faculty; have passed an examination at the end of the year; and have, if required of the faculty, presented a satisfactory thesis; or of (b) at least two years' standing, if they have not taken a graduate course of study in science, provided that they have presented a satisfactory thesis, and passed a special examination for graduation. In the faculty of applied science the M.Sc. will supersede the degrees of Ma. E. (Master of Engineering), and M.A.Sc. (Master of Applied Science). The degree of Doctor of Science (D.Sc.) will be granted to those who have already taken the degrees of M.A., M.Sc. or M.D. It will be given for scientific attainments or research work submitted to the faculty. It will not be an honorary degree, and will only be open to graduates of at least five years' standing.

—The Self-Propelled Traffic Association, of Liverpool, England, has determined to hold another series of trials of motor vehicles for heavy traffic, probably in September, 1899. The previous tests held under the auspices of this association were conducted last year from May 24 to 27. Those interested should address the secretary of the association, E. Shrapnell Smith, Royal Institution, Colquitt street, Liverpool.

REFRIGERATING MACHINERY.

J. & E. Hall, Ltd., inform us that their orders for machines to be fitted on board ship have been well maintained throughout the year, besides a large number for land, this being notwithstanding the fact that they have produced these machines at an average of fourteen per month. At the present time their orders in hand amount to 84 machines to be supplied for ships, and the orders for land machines have also increased. They mention a few of those ordered: For H.M. Admiralty, machines for H.M.S. "Ocean" have just been completed, and those for H.M.S. "Canopus" and H.M.S. "Andromeda" are in progress. The following additional ships are to be fitted: H.M.S. "Formidable," "Pandora," "Bulwark, "Sheerwater." Other machines are in hand for the Russian volunteer fleet, the Japanese Admiralty and Dutch Admiralty. The White Star Line S.S. "Oceanic" is being fitted for the chilled beef trade, and two new ships of the Atlantic Transport Co., for the same; also eight ships for the Hamburg American Steam Packet Co. For the frozen meat trade five steamers to carry 2,000 tons each, of which two ships for Messrs. Tyser & Co., also three ships of the Chargeurs Reunis Co., and two more ships to carry 3,000 tons each. For the importation of butter and bacon from Denmark ships have recently been completed for Thomas Wilson, Sons & Co., United Steamship Co. of Copenhagen. For the Canadian butter and produce trade two ships for J. & A. Allan & Co., are in hand. The Union Steamship Co. have recently had two ships fitted and two more are to follow; also Donald Currie & Co., two ships for importing fruit from the Cape and for preserving the passengers' provisions, etc. Elder, Dempster & Co. also have ordered machines for six ships, and Japanese companies increase the total by six. Machines for land purposes are to be supplied for the Riverside Cold Storage Co., Liverpool, the ultimate capacity of the stores being equal to one million cubic feet of cold storage, half of which is to be started upon at once, and 50 tons of ice per day is to be produced. The Hastings Cold Storage & Ice Co. are also to have a plant completed there by next spring; the Burmah Oil Co. have just ordered a fifth large machine for cooling oil, at their works at Rangoon. There are over 40 on this list of land machines which comprises machines for cold storage, ice making, dairies, breweries, hotels, chocolate cooling, water cooling, etc.

THE MASTER PLUMBERS' ASSOCIATION, MONTREAL.

The Montreal Master Plumbers' Association at their last annual meeting elected the following officers for the ensuing year: Hon.-pres, J. Date; pres., J. Watson; first vice-pres., E. Lesperance; second vice-pres., J. A. Sadler; third vice-pres., Joseph Thibault; sec., N. Lariviere; English cor.-sec., J. W. Hughes; French cor.-sec., J. Lamarch; fin.-sec. J. Montpetit; treas., P. C. Ogilvie. Committees, Sanitary—P. J. Carrol, J. Young, D. Gordon, Jos. Gibeau, N. A. Egan, Arbitration—J. Atcheson, A. Martin, J. Giroux, W. A. Stephenson, R. Egan; Apprenticeship—E. C. Mount, W. J. Graham, H. Brosseau, J. Lafranc, J. Ballantine; Legislative—J. W. Harris, G. Denman, J. C. Brunet, H. Roddon, T. O'Connell. The association will devote a great deal of time to the revision of the plumbing by-laws of the city of Montreal during the year, in the hope that substantial changes in the present regulations may be obtained.

WATER POWER IN THE OTTAWA VALLEY.

There will shortly be published in Ottawa a map showing the water powers available within a radius of 45 miles of the city of Ottawa. An approximate estimate of each power, and leaving out small powers of from 10 to 20 h.p. to be found on every small stream north of the city, aggregates the enormous amount of 890,000 h.p. This is a very conservative estimate, our correspondent writes, based not even on the mean volume of water on each stream, but on a stage between mean and low water. The most important feature of the powers in this district, however, is the fact that the source of supply of each stream rests in large lakes that at small expense for retaining dams can be converted into enormous reservoirs by means of which the powers can be largely increased and regulated during seasons of extreme high and low water. Within 25 miles of Ottawa is the vast water power of the Chats Rapids. It is estimated (from

regular survey), at 120,000 h.p., not a pound of it being now utilized. With unlimited supplies of pulpwood, tan bark, furniture wood, mica, phosphate of lime, plumbago, feldspar, iron and workable mines of galena and gold, and the cheapest and easiest controlled power in the world, Ottawa might be said to be almost destitute of manufactures, and many of these valuable powers are lying idle in the hands of speculators. The vast possibilities of the electric furnace; the fact that so enormous a power can be concentrated at Ottawa by means of the dynamo, and a few miles of copper wire is attracting the attention of manufacturers and capitalists in a way that will, in a very few years, make the Canadian capital something more than a political centre.

MILEAGE OF ELECTRIC RAILWAYS IN ONTARIO.

Editor CANADIAN ENGINEER :

Can you inform me as to the number of miles of electric railways in operation in Ontario. TROLLEY.

Toronto, January 21st.

[The total mileage of electric railways in the province of Ontario to December 31st, 1897, was 291 miles. The figures for 1898 are not yet available, but no important additions have been made during the year.—ED.]

TO SQUARE A SQUARE.

Editor CANADIAN ENGINEER :

I am a subscriber to The Canadian Engineer and wish to ask you for the best way to square a carpenter's square. Yours truly, S. Q. R.

[To test the accuracy of a carpenter's square it may be compared with some standard of recognized correctness; as the standards set up by the various governments, or a square by a maker whose reputation for accuracy is established, as Brown & Sharpe, may be used.—ED.]

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The fourteenth annual meeting of Land Surveyors of Ontario, being the seventh annual meeting since the incorporation of the present association, was held in the rooms set apart for the use of that body in the Parliament Buildings at Toronto on the 28th February, and 1st and 2nd of March. Although, for different reasons several of the regular attendants at the annual meetings were unable to be present on this occasion their places were filled by members from a distance, who enjoyed a rare opportunity of meeting and interchanging ideas with their brethren. Among those present were: A. W. Campbell, H. L. Esten, R. P. Fairbairn, Prof. Jno. Galbraith, K. Gamble, Geo. B. Kirkpatrick, W. A. McLean, C. J. Murphy, Villiers Sankey, Henry Smith, L. B. Stewart, A. J. Van Nostrand, A. P. Walker, A. T. Ward and J. F. Whitson, all of Toronto; Walter Beatty, Delta; Lewis Bolton, Listowel; H. J. Bowman, Berlin; John Davis, Alton; James Dickson, Fenelon Falls; J. D. Evans, Trenton; W. B. Ford, Hamilton; F. L. Foster, Mine Centre; P. S. Gibson, H. H. Gibson and W. S. Gibson of Willowdale; James Hutcheon, Guelph; T. H. Jones, Brantford; Hugh McGrandle, Huntsville; A. J. McPherson, Galt; J. L. Morris, Pembroke; Alexander Niven, Haliburton; J. A. Paterson, Hamilton; John Roger, Mitchell; Geo. Ross, Welland; H. DeQ Sewell, Rat Portage; Angus Smith, Ridgetown; J. W. Tyrrell, Hamilton; W. F. Van-Buskirk, Stratford; H. K. Wicksteed, Cobourg, and T. H. Wiggins, Cornwall. During nearly all the sessions the chair was occupied by P. S. Gibson, president of the association, H. J. Bowman, the vice-president, presiding during the remainder of the meeting.

The morning of the first day having been devoted to committee work the general meeting opened at 2 p.m. After an opening address by the president the report of the Council of Management (including the reports of the Board of Examiners and secretary-treasurer), was read by Major Sankey, and the financial statement submitted to A. W. Campbell and H. L. Esten, auditors. Reports were also presented by the committees on Publication, Repository and Biography and Polar Research. A paper on "Progress of Gold Mining in the Central Belt of the Rainy River District," prepared by H. W. Selby of Dinorwic, and read by H. DeQuincy Sewell, gave a good description of the work being done in developing the natural resources of that section of the province. A paper by F. L. Foster, who has recently returned from a two years' sojourn in the Seine river region, entitled "Surveying in the Mining Lands of Ontario," described the life led by practitioners in the remote parts of the province, giving some of the advantages and disadvantages to be met with in that style of practice. The chairman of the Committee on Exploration presented the report of that committee, comprising some valuable hints as to work required to be done in that direction.

In the evening a paper prepared by C. Unwin, one of the veterans of the profession, was read by his former partner, H. L. Esten, as illness prevented the attendance of the author. Experiences never to be forgotten were detailed, and recalled to the minds of the older members present lively recollections of hardships endured by each in his earlier battles with the wilderness.

A paper on "Some Incidental Benefits from the Growth of Forests," prepared by Thos. Southworth, clerk of Forestry, was read by J. F. Whitson, as the writer had not yet recovered from the effects of grippe. We will discuss this article more at length in a future issue. L. B. Stewart, lecturer in surveying at the School of Practical Science, Toronto, read a carefully prepared paper on "Azimuths," giving formulae for establishing meridians by observations of stars in the vertical of polaris. There is no doubt that when this method becomes familiar to surveyors engaged in work in which observations are frequently required it will be found to be a great boon. "Explorations" was the subject of a paper by James Dickson, inspector of Crown Land Surveys, and it was treated in an able manner. The prevailing idea that the life of a land surveyor during a season in the woods is a perpetual picnic was held to be erroneous, as shown by the effect on the average young man who tries it with that idea uppermost in his mind. It was suggested that for obtaining necessary information respecting the unsurveyed lands of the province, the Government should cause exploratory lines to be so run as to divide the territory into blocks eighteen miles square, these lines to serve as exterior boundaries for future townships.

The morning session of Wednesday, 1st March, was opened by a paper by James Warren of Walkerton, on "The Calculation of Strains in Bridge Trusses," read, in the unavoidable absence of the writer, by J. L. Morris. It was followed by a paper by A. W. Campbell, provincial instructor in road-making, on "Bridges and Culverts for Highways." Both these papers were well received and discussed by members who engage in municipal engineering work. A short paper on "The Use of the Compass for Railway Surveys," was read by J. D. Evans, who was well supported in his statement that the compass, when properly used possesses great advantages over the transit for preliminary work, as its results in the field are more accurate than the plotting of the work can be, while the time required for running a given distance is very considerably lessened by the use of the former instrument. In the afternoon a paper by A. Niven on "The Survey of the Boundary Line Between Nipissing and Algoma Districts," gave a graphic description of the hitherto almost totally unexplored region traversed by a meridian line from the Canadian Pacific Railway to a point on Moose River, near its outlet into James Bay. Major Sankey, who during the past summer represented the City of Toronto in an exploration survey to determine the feasibility of a railway to that seaport, added some valuable information during the subsequent discussion. Next on the programme came a most interesting paper by Lewis Bolton, entitled "A Trip to Yukon and Return," dispelling the common idea that the hardships to be met with in a journey to the land of untold mineral wealth are such as need deter any man of determination and a moderate degree of vigor from undertaking it.

In the evening the annual dinner of the association was held at McConkey's parlors, and proved a most pleasing relaxation. The toast "Canada" was responded to by Sir Sanford Fleming, whose reminiscences of early days were very warmly welcomed. Aubrey White, assistant commissioner of Crown Lands, responded to "Ontario." "Sister Societies" was spoken to by W. T. Jennings, president Can. Soc. C.E., J. Galbraith and Chas. Rust, city engineer, Toronto; Kivas Tully

responded to "Learned Professions" on behalf of the architects. T. Harry Jones, Brantford, won immense applause by reciting Kipling's poem, "Sergeant What's His Name," which fitted well into the strongly imperialistic sentiments of the gathering.

At the Thursday morning session, 2nd March, the presentation of the report of the Committee on Topographical Survey was made by John Roger in the absence of the chairman, Otto J. Klotz. No actual work has yet been begun in this class of survey, but it is expected that in the near future the Dominion Government will inaugurate this much needed work. Vice-President H. J. Bowman next read a paper on "Open Questions," one of the chief of which was the improvement of highways by means of systematic State aid, following the methods now in vogue in the wealthier States of the Union. The report of the Committee on Drainage with "Question Drawer" was read by the chairman, George Ross, and discussed by the members. A. Niven, chairman of the Committee on Land Surveying, presented the report of that committee with Question Drawer containing problems met with by members in all parts of the province; the opportunity of having an advisory board composed of the most experienced practitioners in the association appearing to have been appreciated by those whose practice included these knotty points. "Drains of Field Tile," was the title of a paper read by Captain W. F. Van Buskirk, dealing with an ever increasing class of work within the practice of the majority of the members, as agriculturalists become more convinced that drains, to be effective, must be scientifically constructed.

Afternoon Session.—T. H. Wiggins read a paper descriptive of the "Payne River Drainage Scheme" thus adding a considerable amount of valuable information to the collection already appearing in the annual reports of the association, and from which the work of formulating schemes for the reclamation of waste lands and estimating the probable cost will be greatly diminished. The report of the committee, composed of V. Sankey, G. B. Kirkpatrick and A. Niven, specially appointed last year for the purpose of taking cognizance of any legislation affecting Ontario land surveyors, was presented by V. Sankey, and a bill for the incorporation of the Canadian Society of Civil Engineers in Ontario, was discussed at length. The committee was continued in office with the addition of H. K. Wicksteed and J. L. Morris to its numbers. The president read a circular from the Ontario Historical Society explaining the objects of the exhibition to be held, and bespeaking the co-operation of the members of the association.

Owing to lack of time the following papers and reports were, upon motion, ordered to be taken as read and printed in the Proceedings, viz.: "Permanent Way," by W. E. McMullen; "Our Professional Standing," by B. J. Saunders; "Perche Drain Dredging Work," by J. H. Jones; "Dominion Lands Surveys," by C. F. Aylesworth, jr.; "A Suggested Amendment to the Ditches and Watercourses Act," by Geo. Smith, and the reports of the committees on Engineering and Entertainment. A resolution was passed conveying the sympathy of the association to the families of the following members whose deaths had been reported since the date of the last annual meeting: Jos. DeGurse, Albert Fowlie, Thos. B. Gilliland, T. R. Hewson, Sherman M. Malcolm, J. H. Ogilvie and James A Macmillan. The secretary was instructed to address letters to Jos. Kirk, M. C. Schofield, F. H. Lynch-Staunton and C. Unwin, expressing regret that they had been unable to be present at the meeting and conveying the good wishes of the members in attendance.

In the nominations of officers for the association year 1899-1900 H. J. Bowman, of Berlin, was elected president; F. L. Foster, Mine Centre, vice-president; A. J. Van Nostrand, secretary-treasurer, and A. W. Campbell and H. L. Esten, auditors, all without contest. F. L. Foster having resigned his position as member of council the following candidates were nominated for the three vacancies on the Council of Management, viz., James Dickson, Fenelon Falls; H. K. Wicksteed, Cobourg; W. F. Van Buskirk, Stratford; A. Niven, Haliburton; G. B. Kirkpatrick, Toronto; Jas. Hutcheon, Guelph; Jno. Davis, Alton; A. P. Walker, Toronto, and George Ross, Welland. The voting will be by letter ballots, which will be opened by the secretary-treasurer in the presence of Captain Gamble and J. F. Whitson, scrutineers, on Thursday, April 6. After votes of thanks had been tendered the retiring president and chairman of the council, and graceful acknowledgments returned, the meeting, one of the most interesting yet held, was closed with "God Save the Queen."

—John Burns, the English labor leader, has a forcible article in the Co-operative Wholesale Annual on the risks and casualties of labor. He estimates the number of industrial accidents every year in the United Kingdom at 400,000—which is probably somewhat below the mark. He points out that a thousand miners are killed every year, that 1,334 British sailors were lost at sea last year, that more men were killed in making the Barry Dock than at Balaclava, and that more workmen are killed and injured every week in London alone than in the recent Egyptian campaign.

THE CANADIAN MINING INSTITUTE.

The Canadian Mining Institute held its annual general meeting at the Windsor Hotel, Montreal, March 1st, 2nd and 3rd, when the following papers were read: On Mine Costs; by John E. Hardman, S.B., Montreal; Swedish Iron Metallurgy and its application in Canada, by Dr. James Douglas (president American Institute of Mining Engineers), New York; on the Sampling of Argentiferous and Auriferous Copper, by Dr. A. R. Ledoux (vice-president American Institute of Mining Engineers), New York; on the West Kootenay Ore Bodies, by Messrs. R. G. McConnell and R. W. Brock, Ottawa; Explorations for Iron Ore in Newfoundland and Cape Breton, by C. A. Meissner, Londonderry, N.S.; Notes upon the Development of the Iron Ore Industry, by John Birkinbine, M.E., Philadelphia; on Hydraulic Mining, by John. B. Hobson, M.E., Quesnelle Forks, B.C.; some notes on Prospecting for Wolframite or Tungsten in Cape Breton, by C. A. Meissner, Londonderry, N.S.; An Improved Method of Feeding Water to the Stamp Mill Mortar, by Bernard MacDonald, M.E., Montreal; on Hydraulic Elevators for Gold Gravels, by James Champion, C. & M.E., Barkerville, B.C.; on the Gold Measures of Nova Scotia and Deep Mining, by E. R. Faribault, Ottawa; Across the Pitch versus Up the Pitch, by O. E. S. Whiteside, Ba. Sc., M.E., Anthracite, N.W.T.; the Designing of Metallurgical Machinery, by A. C. McCallum, Peterboro, Ont.; the Adjustments and Control of the Stamp Mill, by Prof. De Kalb, Kingston, Ont.; on the Occurrence of Cinnabar in British Columbia, by A. J. Colquhoun, M.E., Savonas, B.C.; on the Establishment of Science Classes in Mining Centres, by A. H. Holdich, Nelson, B.C.; on Metallurgical Standards, by F. T. Snyder, Vancouver, B.C.; on the Occurrence of Free Milling Gold Veins in British Columbia, by W. Hamilton Merritt, Toronto; Electrical Transmission and Electric Drills, by F. Hille, M.E., Port Arthur; Smelting Conditions in British Columbia, by R. C. Campbell Johnstone, M.E., Nelson, B.C.; A New Device for Thawing Dynamite, by Daniel Smith, Kingston, Ont.; on Acetylene as a Mine Illuminant, by Andrew Holland, Ottawa; A Review of the Canadian Iron Industry in 1898, by George E. Drummond, Montreal; Description of the Sultana Quartz Lode and the Sinking of the Burley Shaft on Bald Indian Bay, by J. Burley Smith, M.E., Winnipeg; on the Lillooet Gold District, B.C., by F. Cirkel, M.E., Vancouver, B.C.; on Palaeontology in its Relation to Mining, by Dr. Henry M. Ami, Ottawa; on the Gold Bearing Sands of the Vermilion river, by J. W. Evans, C. & M.E., Trenton, Ont.; Notes on the Driving of the Simplon Tunnel (Swiss Alps), by Leopold Mever, M.E., Ottawa; Notes on Mining in Quebec, by J. Obalski, M.E., Quebec; A Notable Canadian Deposit of Chromite, by J. T. Donald, M.A., Montreal; on the Petrographical Character of the Ore from the Republic Camp, by Dr. Frank D. Adams, Montreal.

The following subjects illustrated by lantern projections, were also presented: The Designing of Metallurgical Machinery, by A. C. McCallum, Peterborough; Prominent Mines and Smelting Works of the Dominion, by Dr. Geo. M. Dawson, C.M.G., Ottawa; View of Work on the Chicago Drainage Canal, by James F. Lewis, Chicago.

The fact that the meeting was in progress as this issue of The Canadian Engineer was going to press makes it impossible to give a satisfactory report of the convention in this issue, and we shall return to the subject next month and discuss some of the papers quite fully. The following were the officers elected: President, John Hardman, S.B.M.E., Montreal; vice-presidents, Messrs. W. A. Carlyle, Rossland, B.C.; Dr. George M. Dawson, C.M.G., Ottawa; Hiram Donkin, Glace Bay, Cape Breton and George E. Drummond, Montreal; secretary, B. T. A. Bell, Ottawa; treasurer, A. W. Stevenson, C.A., Montreal; council, E. T. Galt, Lethbridge, N.W.T.; S. S, Fowler, Nelson, B.C.; Robert R. Hedley, Nelson, B.C.; Wm. Blakemore, Coal Creek, B.C.; C. A. Meissner, Londonderry, N.S.; J. R. Cowans, Springhill, N.S.; Wilbur L. Libbey, N. Bookfield, N.S.; Clarence H. Dimock, Windsor, N.S.; George R. Smith, M.L.A., Thetford Mines, Que.; J. Obalski, Quebec; Dr. Frank A. Adams, Montreal; R. T. Hopper, Montreal; James McArthur, Sudbury, Ont.; A. Blue, Toronto; Chas. Brent, Rat Portage, Ont., and Eugene Coste, Toronto.

A. E. WILMOT, MEM. CAN. SOC. C.E.

A. E. WILMOT.

The portrait and biographical sketch of A. E. Wilmot was received too late to appear in the February issue of The Canadian Engineer along with the other new officers of the Canadian Society of Civil Engineers, to whose council Mr. Wilmot was elected at the last meeting. In 1868 Mr. Wilmot was assistant engineer on Eastern Extension Railway (now part of the Intercolonial Railway), between Painsac Junction on the St. John and Shediac Railway, and Amherst, N.S. From 1869 to 1874 he was assistant engineer on the survey and construction of the Intercolonial Railway, Miramichi district, and in 1874 to 1876 had charge of a division on the construction of the M.N.C. Railway between Montreal and Ottawa. In 1876 to 1879 he was employed on construction of Canada Central between Renfrew and Pembroke, and on surveys of C.P.R. 1879 to 1881 had charge of a division of 40 miles on construction of the C.P.R. west of English river. In 1881 to 1884 Mr. Wilmot made final location, and had charge of construction of 30 miles of C.P.R. between Harrison river and Yale, B.C., and in 1884 to 1886 he was engaged by the Dominion Government on survey on railway belt from Port Moody, 180 miles easterly, and by Provincial Government of British Columbia on township surveys on Vancouver Island. He was employed in 1887 to 1888 on construction of C.P.R. short line between St. Johns and Sherbrooke, Que., and in 1888 to 1890 was engaged in private practice in British Columbia, including survey on New Westminster and Southern Railway for a water supply for New Westminster city, and survey of town sites in New Westminster and Nelson districts. From 1890 to 1892 Mr. Wilmot was resident engineer on construction of a sewage system for Victoria, B.C., and from 1892 to the present time, city engineer for Victoria, B.C.

The superintendent of the Montreal waterworks wants $210,000 to spend on repairs to turbines, reservoirs, inspection of mains and new services.

THE BRITISH FIRE PREVENTION COMMITTEE.

The British Fire Prevention Committee under whose auspices a testing station was opened at 35 North Bank, Regents Park, London, Eng., January 31st, was founded after the Cripplegate fire of November, 1897, and will now shortly see its full incorporation. It counts a membership of some five hundred architects, surveyors, engineers, municipal officers and others directly or indirectly interested in fire prevention, among whom are practically all the leading members of the profession named. The offices are at No. 1 Waterloo Place, where the library includes a file of some fifty technical journals from all parts of the world, and the regulations and building acts, etc., of all countries. Regular publications are issued by the committee (twelve already having appeared), and meetings are frequently held. The founder was Edwin O. Sachs, architect. Three of the primary objects of the committee are defined as follows: To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures. To use its influence in every direction towards minimizing the possibilities and dangers of fire. To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

It is with the idea of meeting these objects that a testing station has been established.

The purpose of the tests is to obtain reliable data as to the exact fire-resistance of the various materials, systems of construction, or appliances used in building practice. Such data have not as yet been available, owing to the fact that nearly all investigations of this description have been carried out by individual makers, or inventors with specific commercial objects in view. The present tests will be of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability will be assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas. All reports on tests will solely state the bare facts and occurrences, with tables, diagrams and illustrations.

The general arrangement and direction of the tests will be in the hands of the executive, and in accordance with certain principles laid down after careful study and experiment. The actual tests will be attended by the members of the council and the members of the committee in rotation, care being taken that the attendance is always thoroughly representative of the technical professions primarily interested in the specific object under investigation.

LITERARY NOTES.

The Marine Review, Cleveland, O., U.S.A., has made an enlargement of four pages and will publish an issue of 30 pages in future.

The Geological Survey of Canada has recently issued Part S. Annual Report, Vol. X., being the section of mineral statistics and mines of the annual report for 1897. It bears on the cover the names of E. D. Ingall, M.E., and Theo. C. Denis, B.Sc., and J. McLeish, B.A.

By the amalgamation of The Electrical World with another electrical publication W. J. Johnston has retired from active journalism in the electrical field. Though a young man, Mr. Johnston is the father of electrical journalism, as he founded the first paper devoted to electricity. It was for many years published in the interest of telegraphers.

The Royal Electric Co. has just issued a very neat desk memorandum book, which contains in addition to blank spaces for memoranda a vast amount of condensed information of interest to all users of electricity. The tables are exceeding useful. The same company has also sent out a pad calendar, which bears the dates and the praises of the apparatus supplied by the Royal Electric Co.

We have just received from the publishers a copy of a beautiful Religious Reverie, called "Holy Angels" suitable for piano or organ, composed by George D. Wilson. The retail price of this piece of music is 60 cents. All readers of this journal will receive a copy of it, by sending 25 cents in silver, or postage stamps (Canadian or American), to the Union Mutual Music and Novelty Co., No. 20 East 14th street, New York.

H. F. J. Porter, of the Bethlehem Iron Company, lectured to a large audience at the 521st meeting of the Society of Arts, Massachusetts Institute of Technology, recently. His subject was "Modern Forging," and he presented in a very interesting way, with numerous illustrations by the stereopticon, the methods in vogue at the Bethlehem works of forging such articles as hollow and solid shafts, dynamo field rings, guns and armor plate. Defects in the old methods of forging and the steps leading to the present methods were well explained.

We cannot too highly commend the work done by the Thorold and Beaver Dams Historical Society in giving to the public such a comprehensive record of the events which have made that quarter of the Niagara peninsula the Peloponnesus of Canada. The heroic tramp of Laura Secord, 19 miles through a snake-infested woods to warn Lieut. Fitzgibbon of the enemy's approach, the capture of the whole American force by a handful of British as a result of this warning, and many other deeds of daring during the war of 1812, are recounted here, while the less dramatic but equally heroic achievements of peace—the tedious assaults on the primeval forests, the transformation of the woods into wheat fields and of the marshes into gardens—are recorded with a faithful pen. Nor is the industrial and social progress of the township and town overlooked, many instructive bits of history and biography being scattered through the 289 pages of the volume. In fact it is only by the light of such work that the real history of the Canada that is yet to be can be compiled. Much interesting information is given about the Welland canal. The family of Keefer, of whom Thos. C. Keefer, C. H. Keefer and others have been so prominent in the engineering annals of the country, are found among the many sturdy early settlers. The pre-factory days, when the spinning-wheel and the hand-loom were in evidence and the stage coach and ox-wagon were the only means of transport, are truthfully sketched, while the record of the first mills and industrial establishments is very instructive. It is interesting to find, for instance, that Thorold had in 1847 what was undoubtedly the first cotton mill in Ontario, though not the first in Canada, as alleged, for a cotton mill existed in Sherbrooke in 1844, and it is equally worthy of record that this town had the first regular electric railway in Canada, the Thorold and St. Catharines line having been opened on the 5th October, 1887. Taken altogether, the Jubilee History of Thorold is a model of its kind, and is eminently creditable to John H. Thompson, the compiler, and to The Thorold Post Printing and Publishing Co., whose establishment did both the printing and binding.

Industrial Notes.

Lesperance & Theriault, plumbers, Montreal, have dissolved partnership.

Ronald McDonald will establish a machine shop, it is said, in Pictou, N.S.

Edward J. O'Brien has registered as proprietor of the Peoples Plumbing Co., Montreal.

The Bennet Furnishing Co., London, Ont., is about to install a Leonard Engine of the self-oiling type.

T. Dexter, of Sebringville, Ont., has bought the North Branch flour mills, London, Ont., formerly owned by Robb Bros.

Gananoque, Ont., is applying to the legislature for permission to make a loan to Wm. McKenzie to establish a furniture factory.

The Sarnia, Ont., Salt Co. is building a dock, warehouse, etc., and will very shortly be turning out salt and other products.

The Dominion Government has closed a contract for 40,000 bags of cement from the United States at $2.20 per barrel, laid down in Montreal.

There is an amendment to the Ontario Municipal Act which is aimed at the bonus evil. By it only cases of loss by fire are fit subjects for aid from a bonus and then only when a two-thirds vote of the ratepayers qualified to vote has been obtained.

The Iron Manufacturers' Association of Canada met recently in Montreal and advanced prices on manufactured goods owing to a rise in iron prices.

The lumber mill of C. T. White, Apple River, N.S., which was destroyed last spring, will be rebuilt it is understood during the present winter.

The Nova Scotia Pork Packing Co., Middleton, N.S., has employed F. F. Judd, Boston, U.S.A., to supply the plans, superintend the construction of the building and the installing of the machinery.

The very novel and suggestive advertisement of the Penberthy automatic injector on another page conveys very clearly the idea that an ocean of water is supplied to steam boilers all over the world by the Penberthy injectors.

A. L. Davis, W. J. R. Sims, J. R. Stratton, W. G. Morrow and A. A. Cox, Peterborough, Ont., are applying for incorporation as the Trent Valley Peat Fuel Company, Ltd., to manufacture peat for fuel purposes; capital, $5,000; chief place of business, Peterborough.

During the recent elections in New Brunswick a great deal of discussion centred on the bridge contracts which had been carried out by the Record Foundry Co., Moncton, at 6½ cents per lb., at the works. The Dominion Bridge Co. quotes 2.65 to 3 cents per lb. for similar work.

An Ontario charter has been granted to S. A. King, M.D., and O. E. Fleming, Windsor, Ont.; C. M. Walker, W. C. Kennedy, Walkerville, Ont., and J. H. Brown, of Rural Retreat, U.S.A., as the Diamond Harrow Company of Windsor, Ltd., to manufacture agricultural implements; capital, $30,000.

T. Simms & Co., of St. John, who recently purchased the old saw mill, spool and box factory on the German Brook, Hardington, N.B., together with 700 acres of woodland, formerly owned and operated by L. P. Hayden, are putting machinery in the spool and box factory to make brushes.

An interesting folder has reached us from the J. Stevens Arms & Tool Co., Chicopee Falls, Mass., U.S.A., which gives details of the Stevens rifles, of which some new features of great value are the new model pocket or bicycle rifle, and the ideal sporting and hunting rifle, which is very low priced, but accurate in aim, and fully guaranteed by the company.

The boiler in R. O. Konkle's sawmill, Beamsville, Ont., exploded February 18th, causing damage to property in the vicinity. The engineer had just left the boiler room and was unhurt. John Konkle, son of the owner, was injured. The mill building was demolished, and the trees for five hundred yards were damaged, the boiler being thrown that far.

James Wright, of the wholesale and retail hardware firm of James Wright & Co., London, died a short time ago. Mr. Wright, who was one of London's oldest business men, came to Canada in 1858, and after teaching school six years, commenced business in partnership with James Cowan. On the dissolution of that partnership, he went into the wholesale trade, in which he was very successful. From his first settlement in London he took an active part in everything tending to the substantial growth of the city, and was for twenty years a member of the school board.

We have seen plans of the proposed alterations to the Toronto premises of the Union Bank of Canada. When completed, the building will be nearly as wide again as at present, and the front will be on the street line. The banking offices will be inside the easterly entrance, while a new doorway will be placed at the west front. It is intended that the offices other than those for the bank's use, shall be fitted up in a modern manner for general business purposes. The whole effect of the reconstruction will be very fine. Bond & Smith, architects, Temple Building, Toronto, are the architects.

An amendment to the Municipal Act now before the Ontario legislature provides that the corporation shall have power to supply water upon special terms to any corporation or person, whether resident without or within the municipality, including powers to construct, erect and maintain all pipes and mains requisite for the undertaking and for conveying and distributing water to such corporation or person in, upon and through any highway lying between any of their reservoirs, waterworks, pipes and mains and the lands or premises of the corporation or person to be supplied with water.

J. Watson, Kingsbury, N.S., is building a cheese factory near Danby.

The Brantford, Ont., Board of Trade are working for a technical school in that progressive town.

Hespeler, Ont., is anxious to sell W. A. Kribs a site in the park for a box factory, at a nominal figure.

The Robb Engineering Co., Amherst, N.S., has received an order from J. E. & G. Lake, Fortune Bay, Nfld., for a 40 h.p. engine and boiler.

D. G. and F. Loomis, Sherbrooke, Que., are buying new machinery to fit up their new wood-working shops in the Gas and Water Co.'s building.

The jail, Toronto, requires a new 70 h.p. boiler, as the Boiler Inspector has condemned the present one as too small for the present service required.

McKay Bros., East Hatley, are putting in one of the Jenckes Machine Co.'s steam plants, consisting of a slide valve engine and horizontal tubular boiler.

The farmers at Fort Saskatchewan, N.W.T., are organizing a company to build a flour mill; $30,000 stock has been subscribed. The secretary is W. Griesbach.

Halifax, N. S., will grant exemption from all taxes to new industries investing at least $10,000, except a tax of 1 per cent. on the value of the real estate occupied.

Thomas Lord, of L'Epiphanie Station, Que., is increasing his plant by the addition of a 35 h.p. engine from the well-known builders, the Jenckes Machine Co., Sherbrooke, Que.

The MacGregor-Gourlay Co., Galt, Ont., has a rapidly increasing export trade. One of the firm's largest wood working machines has just been shipped to Glasgow, Scotland.

Macphee and Meader, of Moulinette, Ont., propose to build a $10,000 flour mill of a 100 barrel capacity at South Finch, Ont. They will ask for a site, exemption from taxation and a cash bonus,

The Owen Sound, Ont., Iron Works Co., Ltd., has been granted Ontario letters patent; capital, $20,000. The incorporators are J. M. Wilson and Margaret Wilson, George Menzies and Lora Menzies, and Edward Todd.

A sawmill is being built at Springhill, York Co., N.B., by John Campbell, jr. He has ordered a 100 h.p. engine and boiler, and other machinery, from the Robb Engineering Co., Amherst, N.S.

David Ouellet, architect, Montreal, is preparing plans and specifications for a new wing to be added to the seminary of Rimouski, and also for the extension of the College at St. Anne de la Pocatiere, Que.

Geo. Long, Sherbrooke, Que., whose increasing woodworking business requires more motive power, is about to instal a 25-inch Crocker turbine, in order that production may cope with the demand. The order was placed with the Jenckes Machine Co.

An Ontario charter has been granted to W. J. McMurtry and W. T. Eagen, Lillian L. McMurtry, T. C. Harding and F. C. Cooke, Toronto, as the Gold Medal Furniture Manufacturing Co., Ltd.; capital, $100,000; to carry on the business of W. J. McMurtry.

At the annual meeting of the Montreal Rolling Mills Co., after the presentation of a satisfactory statement for the year, the following directors were elected: Andrew Allan, president; Hugh McLennan, vice-president; Hon. G. A. Drummond, E. S. Clouston, Wm. McMaster, Henry Archbald and H. M. Allan.

A test was made in Montreal recently of a fire-proof coating for ceilings, etc., called Salamander, by the American Fireproofing Co., Boston. The test is said to have been very successful, and a double wooden floor with Salamander interfilling withstood a hot fire for an hour. This material is said to have been in use in Boston for about sixteen years.

Judgment was given in the Exchequer Court, Ottawa, March 1st, in the cases of the Wellsbach Incandescent Gas Light Company, the Auer Incandescent Light Company, and the Manitoba Auer Light Company v. Anderson, finding that there has been an infringement of the patent. An injunction is issued, and the defendants are ordered to give up all stock made under the infringement.

Windsor, N. S., will buy a steam fire engine to cost about $5,000.

Incorporation is being sought for a company to take over the business of Rhodes, Curry & Co., Amherst, N.S.

The directors of the Toronto Cold Storage Co. are: Thos. Long, president; H. M. Pellatt, vice-president; Wm. McKenzie, Fred. Nicholls and A. E. Ames.

Last year the Hamilton, Ont., sewage disposal works handled sewage at one outfall at a cost of $9.65 per million gallons, and at another, $14.75 per million gallons.

Secord & Quackenbush, Niagara Falls, N.Y., will, it is said, move the Chippewa, Ont., flour mill to Niagara Falls, Ont., and enlarge it to a capacity of 200 barrels per day.

F. Maundrell, A. Leishman, F. Minns and A. L. Schram, Woodstock, Ont., and A. Elliot, Toronto, are applying for incorporation as the Woodstock Metal Working Company, Ltd.; capital, $5,000.

E. Wallace, T. Ahearn, W. Y. Soper, R. Quain and R. W. Shannon, Ottawa, have been incorporated as the Ottawa Building Company, Ltd., capital, $200,000. The company will do a building and loan business.

The North American Fence Supply Co. is applying for incorporation; capital, $40,000. The incorporators are: A. H. Cook, A. Hood, Markham, Ont., A. Hood, Toronto, W. Chester, J. Hall, T. Hood, W. McCowan, T. Britton, township of Scarboro, Ont.

J. C. Walker, E. J. C. Walker, W. Bell, Isabella M. Bell and W. J. Bell, Guelph, have been incorporated as the Electric Boiler Compound Co., Ltd.; capital, $15,000. The company will deal in engine supplies generally and in Walker's Electric Boiler Compound.

F. A. Hilton, C. J. R. Stirling, J. H. Thompson and E. B. Freeland, Toronto, John G. Bowes and T. W. Lester, Hamilton, Ont., have been incorporated as the Voelker Light Company of Toronto, Ltd., to deal in devices for illuminating and heating; capital, $40,000.

Hon. George A. Cox, E. Gurney, E. B. Ryckman, Richard Garland, of Toronto, and W. Y. Soper, of Ottawa, have bought out the entire American interests of the Dunlop Tire Company. The company has been incorporated under a Dominion charter, with a capital of $500,000. The American and Canadian businesses will be conducted separately.

W. P. McNeil & Co., of New Glasgow, are reported as being very busy on a lot of bridge work for the Provincial Government, in the Industrial Advocate, Halifax, N.S. They have recently placed in position a 15 h.p. horizontal engine from the workshops of the I. Matheson Co., which will be used to operate a Sturtevant blower in the foundry of the establishment.

We see by the Hamilton, Ont., papers that the Greening Wire Co. has in contemplation additions to its buildings and improvements to its manufacturing facilities, and has asked the city council to fix its assessment for the next ten years. We are pleased to see the prosperity of its business warrants the Greening Wire Co. in further enlarging its premises.

R. G. Reid & Sons have formed a large company, under the name of the Newfoundland Bleached Pulp Company, with a capital of two million dollars. The scheme also includes the formation of the Newfoundland Pyrites Company, with a capital of one million five hundred thousand dollars. Mills are to be erected at Grand Lake, Newfoundland. Another important venture under the immediate direction of this firm, is the Western Newfoundland Oil Company, which has recently purchased two extensive oil plants, which will shortly be in operation.

At the inaugural meeting of the Toronto Technical School Board, held last month, A. F. Wickson and Charles March were elected chairman and vice-chairman, respectively, and the following committees were struck: School Management—D. J. O'Donoghue, Prof. Galbraith, Robert Glockling, A. M. Wickens, W. A. Langton; property, F. B. Polson, Chas. March, John Tweed, Ald. Crane, Ald. Hallam; finance, Ald. Hallam, Ald. Sheppard, W. J. Wilson, P. T. Trowern, Dr. Orr; printing and supplies, Robert Glockling, D. J. O'Donoghue, Ald. J. J. Graham, W. J. Wilson, W. A. Langton. The financial statement gave the receipts for the year as $12,098.87, and the expenditure $12,181.22, leaving a deficit of $81.22.

H. J. Johnston, R. C. Miller, D. Ogilvy, J. W. Harris, T. A. Morison, A. Collyer and W. J. McGee, Montreal, are applying for a charter as the Diamond Light and Heating Company of Canada, to manufacture and deal in lamps, stoves, etc., which burn petroleum and other illuminating oils; capital, $200,000; chief place of business, Montreal.

R. MacKay, J. Beattie, H. Paton, D. Macmaster, Montreal, and C. MacKenzie, Toronto, are applying for incorporation as the Shedden Forwarding Co., Ltd., to transfer freight and luggage and produce, which is also to be held in cold storage by the company. The chief place of business, Montreal; capital, $700.000.

The Willson Carbide Works Co., of St. Catharines, Ont., will build new works on a very large scale as soon as a suitable power location can be obtained, but the Merritton plant will not be closed, but operated, as at present. The extension is due to the fact that the present works cannot keep up with the rapidly growing demand.

Geo. F. Baird, James Manchester, Joseph Allison, Thos. H. Bullock, D. J. Purdy, Jas. F. Robertson, R. C. Elkin and A. H. Hanington have applied for incorporation as the Portland Rolling Mills, Ltd., with a capital of $90,000 in $100 shares, to carry on the business hitherto conducted on the Strait Shore by the James Harris Co., Ltd.

The Alberta Irrigation Company, of which E. T. Galt of Lethbridge, N.W.T., is president, has commenced work on a mammoth scheme to reclaim lands between Cardston and Lethbridge, in South Alberta. Sixty miles of canals will be built. The sum of $500,000 will be expended, and 500,000 acres of lands irrigated. The main canal is to be finished next year, and the laterals in the following season. It is proposed to sell the lands on low terms, the settlement of the district being of primary importance.

A gas explosion at the Goodison Implement Works, Sarnia, recently did considerable damage to the company's property. In the blacksmith shops the forges are blown by patent blowers. Shortly after the fires had been started the machinery was stopped to adjust a pulley. During the temporary shut down the fires burned low and a quantity of gas accumulated, so much so that when the machinery started and the blowers were put in operation a terrific explosion took place. Fortunately no one was hurt, but the windows of the shop—sashes and all—were blown out by the force of the explosion.

At a general meeting of the shareholders of the Abbott Mitchell Rolling Mills Company, Belleville, Ont., held for the purpose of completing the organization, the following were elected directors: C. Bard, banker, Norwich, Conn.; John Mitchell, banker, of Norwich; Frank A. Mitchell, foundryman, of Norwich, president and managing director; Wm. Abbott, foundryman, of Montreal, vice-president and secretary; Henry Pringle, manufacturer, Belleville, treasurer; and S. S. Lazier, of Belleville. Considerable time was spent in the drafting of by-laws and regulations relating to the company and works. The plans for the buildings, etc., are all completed and in the hands of the engineers, and it is the intention of the company to start work as soon as possible.

A number of Canadian manufacturers met recently in Toronto at the Board of Trade to consider the situation in respect to the Standard Oil Company not being able to supply manufacturers with fuel oil. There were present: A. E. Kemp, chairman; W. A. Kemp, of the Kemp Manufacturing Co; E. R. Thomas, of the Lozier Bicycle Company; George E. Evans, of the Dominion Bridge Company; J. B. Muir, of the Ingersoll Packing Company; R. H. Verity, of the Verity Plow Works, Brantford; Clarkson Jones, of the D. F. Jones Company, Gananoque; J. K. Osborne, of the Massey-Harris Company; G. Gillies, of Gillies & Co., Gananoque, etc. A thorough discussion took place, in which it was shown that in fuel oil, 2½ cents per imperial gallon should be taken off, to enable anti-trust producers to compete with the trust now controlling the Canadian market. A deputation was appointed to wait upon the Government in the matter.

The Beaver Portland Cement Company was recently incorporated with a capital of $150,000, to manufacture Portland cement in Canada with works at Dry Lake, near Marlbank, Ont. It will be under the management of Wm. G. Hartranft, Philadelphia, and the mills will turn out 600 barrels per day. The president is James Dobson, of the carpet manufacturing firm of John and James Dobson, Philadelphia; the vice-president, R. Peverly, president of the Commercial Wood and Cement Co., New York and Philadelphia; R. T. Hopper, Montreal, is the managing director and treasurer of the company. The Commercial Wood and Cement Co. has been appointed sale agent for this company's cement, and their offices will be located in the Canada Life Building, Montreal, under the management of J. F. Twamley. The head offices of the Beaver Portland Cement Co. will also be in the same place.

R. H. Griffin, president of the City Bank, Buffalo; the Hon. T. G. Smith, Buffalo; George Gudewill, New York; A. F. Gault, George E. Drummond, Thomas J. Drummond and James T. McCall, of Montreal, have organized the Canada Iron Furnace Co., Ltd., of which Geo. E. Drummond is managing director, to establish a smelting plant at Midland, Ont. The town will grant a bonus of $50,000. The company guarantee a minimum output of 60 tons of charcoal pig-iron per day. The work would be carried on at least 200 days in the year with an output of not less than 18,000 tons per annum; it also guarantees to employ an average of 70 men directly at works in connection with the smelting and other necessary operations, and further, an additional 130 men in connection with the tributary general operations of the company.

A. Green's fuel economizer was placed in the main pumping station of the Toronto waterworks some time ago. The apparatus was to stand on its merits, and now the engineer in charge of the pumping plant reports that it has effected a great saving in one test, 12.65 per cent., and the assistant city engineer, who has control of the waterworks system, states that the true saving is very small, and in some instances a loss has occurred. Comparing the years 1896 and 1898 Mr. Fellows computes an actual loss of 3 6-10 per cent., rather than a gain, by using the economizer. Under favorable conditions, he admits, the apparatus may be fuel-saving, but these conditions do not obtain, he says, at the pumping station. He therefore does not recommend its acceptance. The public will wait with interest for the settlement of the matter.

A bill now before the Nova Scotia legislature will incorporate the Dominion Steel and Iron Co. Its capital is fixed at $10,000,000, with power to increase to $20,000,000. Before the company can commence operations it must have $1,000,000 of its capital subscribed, and 25 per cent. of this paid up. The men who are in this new company are practically the same as those who compose the Dominion Coal Company. At the head of the list of incorporators is Henry M. Whitney, of Boston; H. F. Dimock, of New York; Almeric Page, of New York; and W. B. Ross and B. F. Pearson, of Halifax. The charter gives the company almost unlimited power in carrying on iron manufacturing operations. They have already bonded extensive iron areas in Belle Isle, Newfoundland, for $1,000,000, and it is their intention to erect blast furnaces and smelting works in Cape Breton. Muggah's Creek, C. B., has been spoken of in connection with the establishment of the works. The iron areas at Belle Isle, for which $1,000,000 will be paid to the Nova Scotia Steel and Iron Company, who now own them, are estimated to contain 30,000,000 tons of ore.

The manufacturers of Montreal are up in arms against the proposal to tax machinery and manufacturing plants generally. A vigorous protest has been sent in to the Quebec legislature signed by the following, among others: John McDougall, The Shearer & Brown Co., The James Shearer Co., Consumers' Cordage Co., Ltd.; Canada Switch & Spring Co., Ltd.; The Singer Manufacturing Co., The Montreal Rolling Mills Co., The Thos. Davidson Mnfg. Co., Ltd.; The J. C. McLaren Belting Co., Dominion Wadding Company, The Bishop Engraving and Printing Co., The Sunlight Gas Company, Ltd.; John Date, Thos. Robertson & Co., Ltd.; McFarlane, Son & Hodgson, Gazette Printing Co., Montreal Lithographing Co., W. W. Ogilvie, Montreal Horse Nail Co., Pillow & Hersey Mnfg. Co. B. J. Coghlin, The Canada Sugar Refining Co., The James Cooper Mnfg. Co., J. & T. Bell, The James Robertson Co., Ltd.; F. Tremblay, The Canada Paint Co., Ltd.; The Canada Machinery Agency, Graham & Co., Wm. Clapperton & Co., R. H. Buchanan & Co., Thompson Shoe Co., J .C. Wilson & Co., Major Manufacturing Co., Ltd.; Canada Paper Co., Collyer & Brock, Belding, Paul & Co., Phillips Electrical Co.

Electric Flashes.

A project is going forward to light St. George, Ont., with electricity.

The Maritime Electrical Association will hold a convention about April 18th in Halifax, N.S.

The British Columbia Electrical Supply Co. is applying for incorporation to do business in Rossland, B.C.

H. D. Symmes of St. Catharines has recently installed one of the Royal Electric Company's 35 light, four pole, direct current dynamos.

The Port Perry Electric Light & Power Co. has given the Royal Electric Company an order for a 2½ k.w. four pole exciter, to replace the exciter at present installed there.

S. W. Bradley, Aylmer, Que., formerly one of the chief officials of the Hull Electric Railway, has been appointed manager of the Cornwall, Ont., Electric Street Railway.

A. W. Hepburn, Picton, Ont., is fitting out his steamer with electricity. The order for a 12½ k.w. generator has been placed with the Royal Electric Co., to be installed at once.

The McPherson Shoe Company of Hamilton are installing in their works one of the Royal Electric Company's 50 h.p. "S.K.C." two-phase motors. This is to replace the present steam plant.

The Eclipse Whitewear Company of Toronto, has been changing its motive power and increasing its factory. It has placed an order with the Royal Electric Company for a 10 k.w. four pole 250 volt motor.

John Forman, 644 Craig street, Montreal, announces a very interesting catalogue which should be in the hands of everyone interested in electrical supplies. When writing to ask for it mention The Canadian Engineer.

The C. O'Dell Electric Co. of Annapolis, N.S., recently placed in position a 120 h.p. Leonard-Ball automatic engine, which, together with a new boiler, will permit them to double the producing capacity of the plant.

Brown & Boggs, Hamilton, Ont., have decided to operate their factory by electric power, and are installing a 30 h.p. two-phase "S.K.C." motor. Power for the same being furnished by the Cataract Power Co., Hamilton, Ltd.

Lawry, Sons & Co., of Hamilton, pork packers, are changing from steam to electricity for power, and have placed an order with the Royal Electric Company for a 30 h.p. two-phase "S.K.C." induction motor. They are also lighting their factory throughout by electricity.

An electric cab company has been formed in Toronto by Geo. A. Cox, H. H. Fudger, A. E. Ames and others, which will build horseless carriages in the shops of the Canadian General Electric Co., Peterborough, under the Fischer patents. The equipment is storage batteries.

The Canadian Development Company of Victoria, B.C., has been building a steamer on Lake Bennett, Yukon Territory, and expects to have it ready for its trial trip by April 1st. The boat is lighted throughout by electricity; the plant being furnished by the Royal Electric Company of Montreal, consisting of a C. W. multipolar dynamo, direct connected to a horizontal ideal engine.

A company has been organized to operate the Buffalo Railway Co., the Buffalo Traction Co., the Buffalo, Bellevue & Lancaster Railway Co., the Buffalo & Niagara Falls Railway Co., the Buffalo & Lockport Railway Company, the Niagara Falls Park & River Electric Railway Company (Canadian), the Niagara Falls & Clifton Bridge Company, and the Lewiston & Queenston Heights Bridge Company.

The corporation of the town of Barrie has been advertising for tenders for alternating current apparatus. The contract for one 120 k.w. "S.K.C." two-phase alternating current generator for power and lighting apparatus was awarded to the Royal Electric Company of Montreal. The entire lighting and steam plant which has been taken over by the corporation from the Barrie Gas & Electric Company, is being rebuilt and the capacity enlarged.

The Kay Electric Co., Hamilton, Ont., is very busy, and is working overtime.

The Electric Light Co., of Megantic, Que., has been incorporated; capital, $10,000.

Peterborough, Ont., proposes to develop water power for electric supply on the Otonabee river.

The Magnetawan, Ont., Tanning and Electric Co., Ltd., has increased its capital from $50,000 to $100,000

F. Poste, recently a student at the Canadian General Electric Co.'s works, Peterborough, Ont., has assumed the management of the Prescott Electric Light Co.

The Central Mnfg. Co., Chattanooga, Tenn., U.S., furnished the pins for the Niagara Falls power plant, as well as the pins and cross-arms for the Lachine Rapids power plant

At the annual meeting of the Hamilton, Ont., Street Railway Company the old directors were re-elected, and Edward Martin, Q.C., was elected president, John A. Bruce was elected vice-president.

The Sturgeon Falls, Ont., Electric Light and Power Company, Ltd., has been incorporated with a capital of $20,000. The provisional directors of the company are: E. A. Bremner, W. G Finley and P. H. Patriarche.

At the annual meeting of the Cataract Power Company, Hamilton, the following directors were re-elected: Hon. J. M Gibson, pres.; James Dixon, vice-pres.; John Moodie, treas.; John Patterson, sec.; J. W. Sutherland and J. A. Kamerer.

J. D. Guay, C. Leon Parent, F. X. Gosselin, J. E. Alfred Dubuc, managing director of the Chicoutimi Pulp Company, Chicoutimi; C. Angers, M.P., Saint Etienne de la Malbaie, and Onezime Cote, Bagotville, are applying for a charter as the Chicoutimi Water and Electric Co.; capital, $125,000.

At the annual meeting of the Hamilton, Grimsby and Beamsville Electric Railway Company a dividend of 5 per cent. was declared, and the directors were elected as follows: C. J. Myles, pres.; W. J. Harris, vice-pres.; L. Bauer, Robert Ramsay, A. H. Myles, John Gage. A. J. Nelles was reappointed secretary and manager.

The Niagara Falls, St. Catharines and Toronto Railway Company is applying for incorporation with power to take over the St. Catharines and Niagara Central Railway Company, and to extend to Port Dalhousie and Hamilton; also to acquire, generate, use and sell electric power; and operate steamboats, wharfs, etc.

The Packard Electric Co., Ltd., St. Catharines, Ont., is placing on the Canadian market Brunt's regulating socket, which is claimed to control the electric light as easily as a gas burner does gas light. There are five degrees of light, from two candle-power to sixteen, and a positive saving of current is claimed. This socket is specially valuable for the sick room, vestibules, sleeping apartments, etc.

The number of electric lighting companies in Canada for the fiscal year ending June 30th, 1898, was 267. The revenue derived from the inspection of electric light was as follows: The fees for the inspection of meters, etc., $5,388.25; for registration of companies, $3,900, and for penalties, $114; making a total of $9,472.25. The expenses of inspection (annual), were $3,236.10, the amount expended on standard instruments, etc., $3,768.80, leaving a net revenue of $2,467.35.

At the annual meeting of the Bell Telephone Company the following statement was submitted: 1,637 subscribers have been added during the year, the total number of sets of instruments now earning rental being 32,082. The company now owns and operates 343 exchanges and 340 agencies. Six hundred and sixty-six miles of wire have been added to the long-distance in 1898; of these, 326 miles are in the Ontario department, and 340 miles are in the Eastern department. The long-distance lines now owned and operated by the company comprise 17,233 miles of wire on 6,096 miles of poles. The financial statement showed that the net revenue for 1898 amounted to $331,151.74, out of which $263,779.93 were paid in dividends, leaving a balance of $67,371.81, which with the balance from 1897 of $82,364.17 makes a total balance carried forward of $149,735.98. The following directors were elected: C. F. Sise, Robert MacKay, John E. Hudson, Robert Archer, William R. Driver, Hugh Paton, Charles Cassils and Thomas Sherwin.

The Ontario Government gave the electrical industries quite a shaking up in the budget speech, which announced taxes on telephone, telegraph and electric railway companies.

The Royal Electric Company of Montreal has just completed the installation of a 100 h.p. "S.K.C." synchronous motor in the Iron Mask Mine at Rossland, B.C., to operate the hoisting machinery and air compressors.

The amalgamation is announced of the W. A. Johnson Electric Company and the Toronto Electric Motor Company, Ltd. About a year ago the business of the Toronto Electric Motor Company was reorganized as a joint stock company, J. W. Thompson at that time purchasing an interest and combining with it the manufacturing business formerly carried on in Hamilton under the style of the Thompson Electric Company. Recently Mr. Thompson has secured control of the entire business of the Toronto Electric Motor Company, Ltd. This company and the W. A. Johnson Electric Company have amalgamated their manufacturing business under the style of the "United Electric Co., Ltd;" capital, $150,000, with head offices at 134 King street west, Toronto. Both factories will be operated at present. Arrangements are, however, being made for a considerable extension of their manufacturing plants. The officers of the new company will be: W. A. Johnson, president and managing director; J. W. Thompson, secretary and treasurer; J. Norman Smith, engineer-in-charge of works.

The Mercury, Renfrew, Ont., says recently: We have always understood that the average life of an incandescent lamp was 800 hours. Some live considerably less. Others more. Two of these have their death recorded in the following fashion by A. A. Wright in a letter to the Packard Co.: These lamps have burned an average of ten hours a day since installed and every day. Consequently their life has spanned some 20,350 hours. It was somewhat remarkable, too, that having both lived so long they should have gone out so nearly together. Their epitaph is as follows: In faithful memory of Incandescent Packard, jr., and Incandescent Packard, sr., twin sisters. They were born of an honorable parentage, viz., The Packard Electric Co., now of St. Catherines, Ont. They each entered this life and commenced their remarkable career, Dominion Day, July 1st, 1893. Having commenced their labors on the switchboard in A. A. Wright & Co.'s Electric Light Station, Renfrew, Ont., on the installing of their electric light plant on the above mentioned date, they there burned faithfully and well every night without intermission until the time of their death. I. P., jr., departed this life, Feb. 1st, 1899, at the ripe old age of 5 years, 7 months; I. P., sr., shuffling off this mortal coil a few days later, Feb. 9th, 1899, at the advanced age of 5 years, 7 months and 9 days. During all these years they let the light shine in the above mentioned place every night, laboring side by side, thus setting an honorable example to all their neighbors, and saying in their peculiar way, "Go thou and do likewise."—(If you can).

Orillia, Ont., has awarded the contract for the electric power transmission plant subject to the by-law being approved of by the ratepayers. The Central Construction Co., Buffalo, is contracting for the entire equipment. The Stillwell, Bierce & Smithvale Co., are sub-contractors for the water wheels. The electric machinery will be furnished through W. A. Johnson Electric Company, of Toronto, the plant to consist of two 400 h.p. revolving field Westinghouse, three-phase 60 cycle generators, each having an overload capacity of 60 per cent. These will be located at the Ragged Rapids on the Severn river, eighteen and a half miles from Orillia. There will be provided the necessary high tension switchboards and controlling apparatus. Six step-up 100 k.w. static transformers, self-cooling type, will raise the voltage to 22,000 for the transmission line. At the receiving station at Orillia there will be six step-down 100 k.w. transformers of a similar type, to reduce the pressure to 1,000 or 2,000 volts, so that the alternating incandescent circuits now used for commercial lighting can be connected direct to the above transformers. There will also be provided a 25 h.p. Tesla induction motor, for driving the waterworks pump, now operated by steam, and a 50 h.p. motor of same type to drive the three ball, 25 light, arc dynamos, which have been used for street lighting for some years. The switchboard apparatus, lightning arresters, etc., have been carefully selected and so arranged that uniform service and safety in handling can be relied upon, notwithstanding the high voltage.

Railway Matters.

It is reported that a union station will be built at Megantic for the use of the Canadian Pacific and Quebec Central Railroads.

The Dauphin railway is going to establish workshops at the town of Dauphin, and machinery has already been ordered for their equipment.

A million dollar scheme is on foot in Montreal to elevate the G.T.R. tracks in Montreal and do away with the level crossings, some of which cause a great deal of complaint.

The Midland Railway Co., Nova Scotia, has bought from the Canadian agent of the Carnegie Steel Company, the rails for the road now being constructed between Windsor and Truro.

The Nickel Range Railway Company is applying for a charter to build a railway from the Algoma branch of the C.P.R., between Whitefish and McNaughton stations, to the main line of the C.P.R. at Chelmsford station, Ont.

W. G. Reid, contractor for the Midland, N.S., railway, has awarded to the Dominion Bridge Company the contract for the steel superstructure required for all the bridges between Windsor and Truro, including those across the St. Croix and Shubenacadie, or about seventeen spans.

The British Columbia Government has cancelled grants made to McKenzie & Mann by the former Government for the construction of a line of railway from Penticton to Boundary Creek; from Penticton to Point Roberts, 200 miles, and from an ocean port in British Columbia to Teslin Lake, 400 miles.

A British Columbia charter is asked for a railway from Log Cabin, on the White Pass, in the province of British Columbia, by the most feasible route, to a point at or near the Taku Arm of Tagish Lake; then to Atlin City, on the shores of Atlin Lake; and thence to Telegraph Creek, on the Stickine River, all in the province of British Columbia.

At a meeting of the directors of the C.P.R. Co., February 6th, the usual 2 per cent. on the preference stock was declared, and a dividend of 2 per cent. was also declared on the ordinary stock, making with the dividend already paid 4 per cent. for the past year. The results for the year were: Gross earnings, $26,138,977; working expenses, $15,663,605; net earnings, $10,475,372. The income from other sources was $423,367, making total net income $10,898,738. The fixed charges, including interest on land bonds, were $6,774,321, leaving net revenue available for dividends, $4,124,417. Out of this a dividend of 2 per cent. on the preference and 2 per cent. on the common stock for the June half year was paid in October last. After the payment of the dividends now declared the surplus for the year carried forward is $1,051,708.

J. R. Booth has given the Canadian General Electric Co., Ltd., a contract for the installation of an electric plant to transmit current for motive power and lighting purposes from his mills at the Chaudiere Falls on the Ottawa to the new Canada Atlantic Railway shops, 3½ miles distant. The contract covers two 150 k.w. three-phase revolving field, 4,000 volt, 60 cycle slow speed generators with switchboard arranged in such a manner that they may be operated single or in multiple. There will be installed at the car and lomotive shops three 130 h.p. 4,000 volt three-phase self-starting synchronous motors, each of which will be connected with the main shafts by means of rope drives and clutch pulleys. The company has also supplied for the large locomotive transfer table, a suitable motor drawing current from conductors placed beneath the floor, and fed from a transformer system at 500 volts. For lighting purposes there will be used sixty alternators, enclosed six ampere arc lamps specially adapted for factory use, together with some 400 16 c.p. incandescent lamps, all of the C.G.E. Co.'s make. The transmission here will consist of three No. 4 B.S. bare copper wires carried on porcelain insulators and extra heavy pole line, which will follow the line of the Canada Atlantic Railway the entire distance.

Trains are now running on the White Pass Railway.

It is said that the Lake Erie & Detroit River Railway Company, the purchasers of the Erie & Huron, will spend $50,000 in building shops at Sarnia and Port Huron. As soon as the shops are completed the car ferry "Huron" will make regular trips between Port Huron and Sarnia.

The Bedlington and Nelson Railway Company is applying for running powers over the Crow's Nest line of the Canadian Pacific Railway. The proposed line would lessen the distance between Kootenay Lake and Bonner's Ferry by 53 miles. The Bedlington road is owned by English capitalists, and when a change was made two years ago, work on the railway was stopped, although the line was staked. Meanwhile the C.P.R. secured the charter for a line from Lethbridge to Nelson through the Crow's Nest Pass.

The Canadian Pacific Railway Company is applying for permission to operate a railway from its Stonewall branch, Manitoba, northerly and northeasterly to a point on Lake Winnipeg between Gimli and Arnes; and also a railway from a point on the one last named, thence in direction generally northwest to a point on the east shore of Lake Manitoba between Marsh Point and the north boundary of township twenty-five; and also a railway from Reston, on the company's Souris branch, in a general westerly direction to the Moose Mountain district, thence in a westerly direction to Regina.

Mining Matters.

There have been received some very fine specimens of gold quartz from the Atlin country, B.C.

Ottawa will have a large mica factory. It will be operated by the Eugene Munsell Company, of New York.

A very rich find of gold is reported from McDonald Creek, Northwest Territory. It is close to the boundary line of British Columbia and the Northwest Territory.

Next summer will witness a greater boom than ever at the Bell Island iron mines in Newfoundland, as the company expect to have 600 men employed on April 1st.

The Centre Star mine at Rossland, B.C., is to be developed and the stock placed on the market, by the same group of capitalists which gave the War Eagle mine such a boom.

W. D. Pettigrew, Winnipeg, who is developing mines at Wabigoon, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for hoisting, crushing and pumping plants.

The Lake Manitou Gold Mining Co., St. Paul, U.S., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a ten stamp mill to be erected on its property near Wabigoon, Ont.

John D. Chipman of St. Stephen, representative of the English company now in control of the Chronicle Co., N.B., nickel deposits, learns that the shipments of ore have proved satisfactory.

The John Sykes Mining and Milling Co., Toronto, has purchased from the Jenckes Machine Co., Sherbrooke, Que., a ten stamp mill, engine, boiler and saw and shingle mill, to be erected immediately on its property near Dinorwic, Ont.

The East Bay Coal Mining Co., is said to be embarking in earnest upon its extensive oil-shale enterprise at McAdams Lake, C.B. Next summer will see extensive developments. The company's expert has recently been over the ground.

The Guffey-Jennings Gold Mining Co., at Caribou, N.S., it is reported, will tear down the old mill located on its areas and replace it with a modern plant comprising 40 to 50 stamps, together with the improved Wilfley Table Concentrator.

The present installation of 30 stamps in the new mill of the Dufferin Mine at Salmon River, was started the other day and everything found to run smoothly and in a satisfactory manner. The mill is arranged for a capacity of 60 stamps, which will give when running a crushing ability of 240 tons every day of 24 hours.

The Hammond Reef Gold Mining Co., Toronto, has decided to install at once, thirty additional stamps, a new crusher, aerial tramway and water power plant, to operate the new mill. It is expected that the whole of the machinery will be delivered early in April. The Jenckes Machine Co., Sherbrooke, Que., has been awarded the contract.

The Hall Mines, Ltd., Nelson, B.C., was expected to start the treatment of lead ores in its smelter about March 1. The company has made a contract with the management of the Queen Bess, a Slocan mine, for the output of that property for the next three months. In addition to this ore, the company is receiving regular shipments from several of the silver-lead mines in the Slocan, as well as from some of the properties around Ainsworth.

Early in December a very rich find of platinum was made on the Hootalinqua, Yukon. Black sand is found in nearly every stream of the Yukon Territory, and while considered a good indication of gold, is always a nuisance to washers. On account of its great specific gravity it remains in the sluice boxes with the gold, and even hand panning will not always separate the two. Twelve pounds of it was taken from near the mouth of the Hootalinqua and found very rich.

The improved condition of the New Glasgow and Bluenose mines, at Goldenville, N.S., is well illustrated in the returns for the month of December last. From 1,500 tons of quartz 650 ounces of gold were obtained, valued at $12,500. The cost of mining and crushing this quantity is stated to have been about $3 per ton or a total cost of $4,500, leaving a balance of profit on the month's operation of $8,000, which, it must be confessed, is a very handsome return.

At the annual meeting of the Hammond Gold Reef Mining Company, the directors in their report to the shareholders announced a policy of active operations for the immediate future. Upon that report the stock has been very active and has made rapid advances in price. A meeting of the directors was held in this city yesterday and a contract was closed with the Jenckes Machine Company of Sherbrooke, for thirty additional stamps, the necessary ore crushers, aerial rope tramway, frue vanners, water wheels, etc. This will give the company a thoroughly equipped 40-stamp mill, and will make it one of the largest and most complete free milling gold mill plants in Canada. A contract has also been let to the Canadian General Electric Company for generators, motors, electric line and complete equipment for the production and transmission of electric power from Clearwater Falls, a distance of less than two miles.

Marine News.

The St. Lawrence canals will be opened for traffic May 1st.

Northwest Transportation Co., Sarnia, Ont., is putting in new boilers in the S.S. "United Empire."

Toronto recently sent a strong deputation to Ottawa to urge the claims of the city to harbor improvement.

The dry dock at St. John's Nfld., was resorted to by 26 vessels in the past year, many of which were in need of considerable repairs.

Application is made to incorporate a company to construct a ship canal from Lake St. Clair to some point on Lake Erie between Point Pelee and Rondeau Harbor.

The C.P.R. declines to allow the city of Toronto to land the proposed chain ferry at the Queen's wharf at a lower rental than $1,500 per year, and so the ferry will remain in abeyance for another season.

The steamer "Minnehaha," which is being built at Seaton Lake, Lillooet, B.C., is a neat model. In the neighborhood of fifteen tons of freight can be carried.

The Canada Steamship Company, of which Sir Robert G. Head, of London, England, is president, and which is now organizing a transatlantic line between Milford Haven, Wales, and Paspebiac, has just prepared designs for the construction of an elevator at the latter place. It is intended to build it of corrugated iron. Its capacity will be 1,000,000 bushels of grain. The construction will begin shortly.

Extensive alterations are being made in the steamer "Greyhound" at St. Catharines, Ont. The steamer "Lakeside" is expected to commence running from St. Catharines to Toronto about the 15th inst.

Two semi-annual dividends of 3 per cent. each, amounting together to $104,400 were paid by the Richelieu & Ontario Navigation Co. during the financial year just closed, leaving the amount of $7,627.55 to be carried to the surplus.

J. L. Booth, Ottawa, stated recently that he would, during the coming season, build sixteen hundred feet more of dockage at Depot Harbor, for the further accommodation of grain to be shipped over the Ottawa, Arnprior & Parry Sound Railway.

Maine, U.S., shipyards are turning out five-masted schooners, and there are no less than four five-masters building in the Maine shipyards at present. The "Nathaniel Palmer," just launched at Bath, Me., is 205 feet long, 44-4 feet beam, 22 feet deep and 2,440 tons gross.

Collingwood Schreiber, Deputy Minister of Railways, has stated that M. P. Davis, contractor for the Gallops Canal, had been granted an extension of time to 1900 to complete his contract, but he will be obliged to provide tugs to tow vessels up stream, there being a sufficient depth of water, but a strong current. The Soulanges Canal contractors have been given to May 15th next to complete their work. There is, however, no certainty that they will be through in that time.

Personal.

T. A. S. Hay, C.E., has been appointed city engineer in Peterborough, Ont.

Geo. White Fraser, D.L.S., Toronto, is engaged on the survey of the boundary between British Columbia and the Yukon district.

We recently had a visit from J. B. Moore, representing the Ashcroft Mnfg. Co., the Consolidated Safety Valve Co., the Hayden & Derby Mnfg. Co.

Jenkins Bros., valves and packing, the famous New York and Boston house, is now represented in Canada by H. C. White, who is just now making the round of the trade.

Wm. Butterick was accidentally killed in Deseronto, Ont., February 6th, at the Standard Chemical Works, by being caught in a shaft. His father is superintendent of the Rathbun Co.'s lumber mill.

Hugh Ryan, the contractor who built the Sault Ste. Marie canal, and in the earlier days a large section of the G.T.R., died in Toronto, February 13th, leaving an estate of almost one and a half millions of dollars.

D. C. Smith, who travels in Canada for Henry G. Thompson & Son, New Haven, Conn., U.S.A., has recently visited Toronto in the interest of that firm's famous hack saws, and band, power and jig sawing machines for cutting metal.

It is reported that Mr. Louis Coste, chief engineer of the Public Works Department of Canada, has forwarded his resignation to the Minister of Public Works. His purpose is understood to be to take the management of the Dominion Yukon Mining Company.

George C. Morrison, Hamilton, Ont., died recently at his home. Mr. Morrison was a native of Kirkentulloch, Scotland, but came to this country when a very young man. About 34 or 35 years ago he came from Galt to be foreman in Beckett's Engine Works, and 30 years ago he went into business for himself, starting the engine and boiler works which he has ever since carried on in Hamilton.

FIRES OF THE MONTH.

Jan. 31st. American Bent Chair Co., Owen Sound, Ont., loss, $150,000.——Feb. 7th. The Columbia River Lumber Co.'s (Vancouver) sawmill at Moberly.——Feb. 11th. Dunn's sawmill, Sault Ste. Marie, Ont.; loss, $5,000.——Feb. 12th. L.E. & D.R.R. Co. round-house, Sarnia, Ont.——Feb. 13th. The Geo. Gillies Co.'s bolt works, Gananoque, Ont.; $12,000 damages.——Feb. 13th. A large portion of Digby, Ont., was burned down.——Feb. 14th. Wm. Law & Co.'s wharf, Yarmouth, N.S.——Feb. 14th. J Saunders' wood-working and blacksmith shop, Sunderland, Ont.; loss, $1,000.

A NOVEL METHOD OF SEWAGE DISPOSAL, ESPECIALLY DESIGNED FOR THE CITY OF TORONTO.

(Concluded from January issue).

In the foregoing, the lift from the pump well to the filtration area, recommended by Mr. Rust, has been assumed to be only 70 feet vertically. This is not correct, the elevation being much greater, as I am now reliably informed. So much so, indeed, as to bring the annual cost of maintenance by my combined method, up to $100,000 or more. This, in view of the much more economical second alternative plan, is almost prohibitive. The artificial filters referred to may now be considered as offering the better method of subsidiary, and final purification. The long, narrow spit of land between Ashbridge's Bay and Lake Ontario presents an excellent location for the small area required, and can be reached by gravity within a moderate distance from the coke and combustion works, should local circumstances prevent their location in close proximity to the latter.

The half acre of coke and six acres of sand and gravel filters already mentioned, would be sufficient, as at Reading and Glasgow, but, inasmuch as coke would require frequent renewal, and the other materials are to be had in abundance in the locality designated, it would be more economical to lay out 8 or 10 acres of sand and gravel beds at a maximum cost of, say $40,000. The probability is that quite sufficient material is on the spot *in situ*, and that the filters, on a much more extensive scale, and at very much less cost, could be made out of the sand.

The total cost of the whole plant, including coke and combustion works on the line of the outfall sewer, the filtration area, and a possible mile of conduit pipe from the works to the filter beds, would be, approximately, as follows:

Coke and combustion works	$191,200
Land for above	10,000
Conduit pipe	40,000
Filter beds	40,000
Cost of land, right of way, etc.	25,000
	$306,200

The artificial beds at Reading, Penn., U.S.A., cover an area of 57-100 acre, only, they filter 1,500,000 gallons of sewage effluent daily, and the preliminary coke straining of the "entire" crude sewage is by no means as thorough as it should be, the strainers being changed but once a week, and yet the effluent from these very small filters is satisfactory. In this case (Toronto), the heavy matters of the sewage are entirely held back from the coke strainers, there is constant aeration, and, with a larger filtration area, proportionately, can we not look for even better results?

No sludge, a minimized cost of construction, and a yearly cost for maintenance not exceeding $73,000, which covers the care of the filter beds.

The construction of half an acre of coke filter at the works (at the discharge end of the pumps), would add greatly to the purity of the effluent from the sand and gravel filters at Ashbridge's Bay, and be well worth the outlay. Such a filter would cost about $15,000, and bring the total outlay for construction up to $321,200. It would probably suffice to renew such a filter at the rate of, say ten tons daily, which, as the coke from the strainers in the receiving reservoirs, would be utilized as fuel, and pay for itself.

The fact that bricks are more or less magnetic in their properties has been recently demonstrated by H. E. Lawrence of the Physics Laboratory of Rochester University, Rochester, N.Y.; the investigation is still proceeding, and we will give details of the experiments when they have been completed. The magnetic instruments in the Observatory at Toronto are housed in a structure in which no brick was used, and the director states that they have had no trouble of the kind which led to the discoveries at Rochester.

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D. THEUNISSEN, Cookshire, Que.

The Canadian Engineer

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The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

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FOR THE CANADIAN ENGINEER.

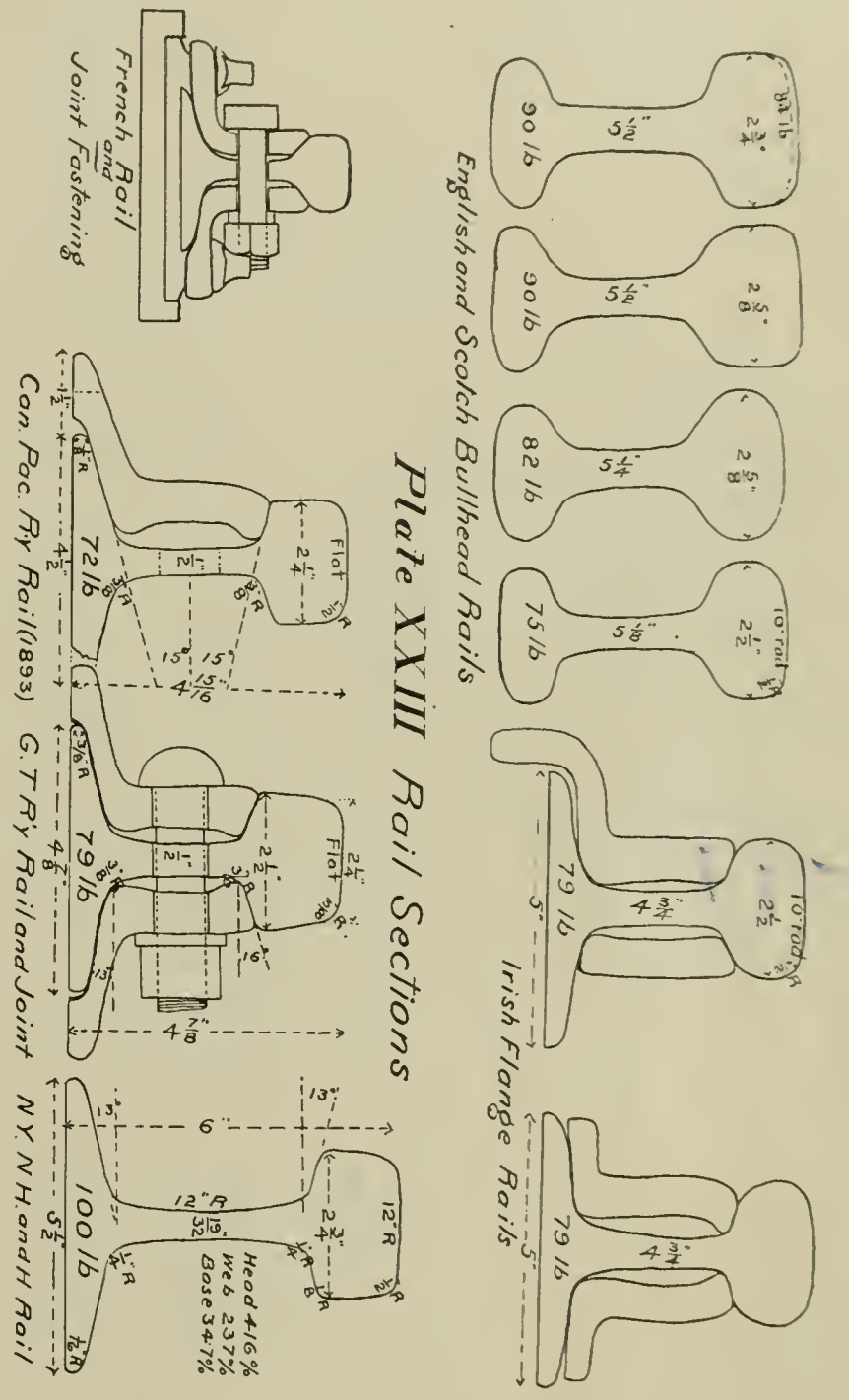
RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

ARTICLE 4.—RAILS.

The progressive history of rails from the first longitudinal wooden sleepers up to the present would be interesting but not in place here. We have arrived at two types, one used in England and Scotland, and in some British colonies and dependencies, etc., i.e, the bullhead or double-headed rail, resting in cast-iron chairs, the other used in the world generally, otherwise, (i.e)., the Viguoles or flanged rail, which is self-supporting.

(A) Plate XXIII. gives sections of bullhead rails, and on Plate XXV. is shown a cast-iron chair for fastening the rail to the ties, and which adds $1,500 to $2,000 per mile to the cost of the track. The original idea involved in the use of this section was to obtain a reversible rail which would double the wearing value if it could be turned over and used again after one head had worn down, but when it was found that the chairs damaged the rail so that they could not be reversed advantageously, this idea was abandoned, and the section now used has a much larger per cent. of metal in the head than in the base of the rail. The British railways use rather heavy rails considering the light rolling stock, but space their ties 2 feet 6 inches apart, centres, due to the superior supporting qualities of the cast-iron chairs; and, in general, the tracks are very solid and first-class, the rails being held to the chair-seats by long tapering oak keys which are tightened occasionally, while the chairs themselves are fastened to the ties with wood screws and bolts, and even those few British or Irish roads which use flanged rails use the same fastenings with tie plates, not trusting to spikes except at every other tie at the most. A special advantage in using rail chairs is that creosoted pine ties become available, and they are probably the most durable and economical tie in use, where it becomes possible to fasten the track securely to them.



(B) *Flanged Rails.*—The objections urged against flanged rails, that they cut into the ties, and that they cannot be held properly for heavy traffic with spikes, are overcome by adopting tie plates and screws or bolts for fastenings, and the idea that they are not rigid on curves is shown to be erroneous, as witness the very heavy engines of America running at high speed around much sharper curves than are used in England.

Plates XXIII. and XXIV. give sections of flanged rail of various designs and origins. In detail they will be found to vary widely, but with the exception of the New

*Now issued in book form.

York Central rail, which has a narrower base for use with tie plates or steel ties, the height is usually equal to the width of base. The first difference noticeable is the per cent. of metal in the head. Other things equal, the more metal in the head the more wear will be obtained, but rails with relatively heavy heads never cool equally,

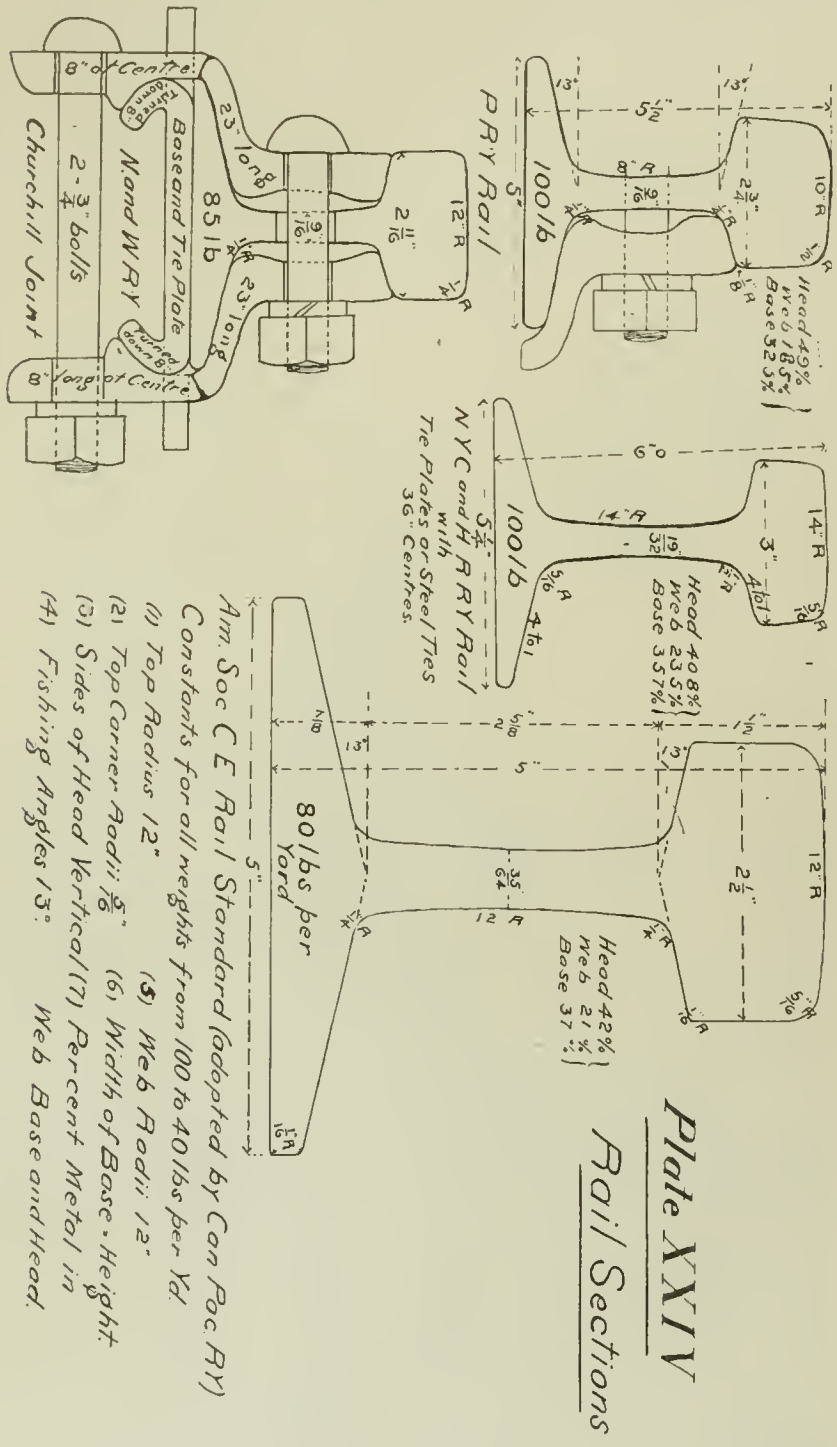


Plate XXIV

Rail Sections

causing initial strains in the section, and a deep heavy head will not get well rolled, and being spongy will wear rapidly when the top layer is gone. The endeavor now is to get a rail as hard as possible, chemically, that will stand drop tests, with a wide, moderately deep head, but not so deep as to induce sponginess in the centre of the head. A wide head is necessary with modern heavy engines to prevent undue crushing of the top surface, due to heavy concentrated wheel loads, and this forces a small proportionate depth of head to keep the per cent. of metal in the rail head from being excessive.

Striking differences in rail design occur in the radius of the top of the head, the upper head corners, and in the side slopes of the head. The tendency in America is toward a flat top, sharp corners, and vertical sides, which is the reverse of English practice of round tops, easy corners and sloping sides, while fishing angles are getting flatter and tend to become standard at 13°.

Plate XXV. gives a standard U. S. wheel tread—rails after eleven years' wear on curves, and two drawings which contrast the fit of a wheel on a rail head of sharp corner radii with that on one of larger radii. It will be seen by the dotted lines that normal wear is upward and outward, thereby increasing the arc of contact between wheel and rail, thus also increasing the resistance and wear, so that the longer this can be deferred by starting with a sharp corner radius and vertical sides, the better, as the contact is then a rolling one only, and the wear and resistance small. Note that the radii of worn rail corners is still about ¼ inch, and investigation has shown that sharp radii of upper corners of rail heads do not cause sharp flanges on wheels, which has been the chief objection raised against them in the past.

Composition of Rails.—When steel began to replace iron as a material for rails it was found necessary to remove the notches in the flanges from the centre to the ends, and even omit them altogether to prevent breakage, the notches being put in the flanges of the angle bars instead, so as to prevent creeping of the track. Rails were made hard to stand wear. Then drop tests were introduced to detect brittleness, and soon forced soft rails to be used, but going to the other extreme the rail heads wore out very quickly, especially as the demand for cheapness produced insufficiently rolled rails. Now there is a gradual tendency to get as hard a rail, chemically, as will just stand the drop tests.

Specifications for Chemical Composition of Rails :

(1) Sandberg (Sweden)—Carbon, if alone, $\frac{5}{10}$ p.c., but only $\frac{3}{10}$ p.c. in presence of $\frac{1}{10}$ p.c. phosphorus ; silicon, at least $\frac{1}{10}$ p.c. to give sound ingot and make rail wear.

(2) G. T. R. (Canada)—Carbon, $\frac{4}{10}$ to $\frac{5}{10}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{7}{100}$ or less, silicon, $\frac{1}{10}$ p.c., manganese, $\frac{1}{5}$ p.c.

(3) New York Central Railway (Dudley)—60 to 70 lb. rail : Carbon, $\frac{45}{100}$ to $\frac{55}{100}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus $\frac{6}{100}$ p.c. or less ; 70 to 80 lb. rail : Carbon, $\frac{5}{10}$ to $\frac{6}{10}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{6}{100}$ p.c. or less ; 100 lb. rail : Carbon, $\frac{65}{100}$ to $\frac{75}{100}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{6}{100}$ p.c. or less.

Dudley, also regarding different constituents that affect the quality of rails, says : Manganese takes up the oxide of iron, and prevents red shortness, but over 1 p.c. makes rails not only hard but coarsely crystalline, with a tendency to brittleness, flowing easily under wear and oxidizing rapidly in tunnels. Silicon produces solid ingots, free from blow holes in columnar structure, with small compact crystallization. Sulphur causes red shortness and seamy heads ; it also tends to check welding of blow holes and ingot pipes. Phosphorus increases the size of crystals and produces brittleness ; it must therefore be very low in high carbon rails, which make prices higher, as most ores have phosphorus in them.

Physical Drop Tests for Rails :

(1) Intercolonial Railway of Canada—Supports 3 ft. 6 inches apart ; a rail 12 ft. long is to stand one blow of 2,000 lbs. falling 18 ft., and three blows falling 6 feet for 67 lb. rail, with a deflection of 3 to 3½ inches for first, and 2¼ to 3¼ inches for second case. (Drop tests for U. S. roads about the same.)

(2) Irish Flange Rails.—(a) Supports 3 ft. 6 inches apart, a rail not to deflect more than ⅜ inch with permanent set not more than ⅛ inch for 30,000 lbs. at centre for 30 minutes. (b) Same supports, rail to stand 2 blows without breaking, and not to deflect more than 1 inch for 2,000 lbs. falling 8 feet.

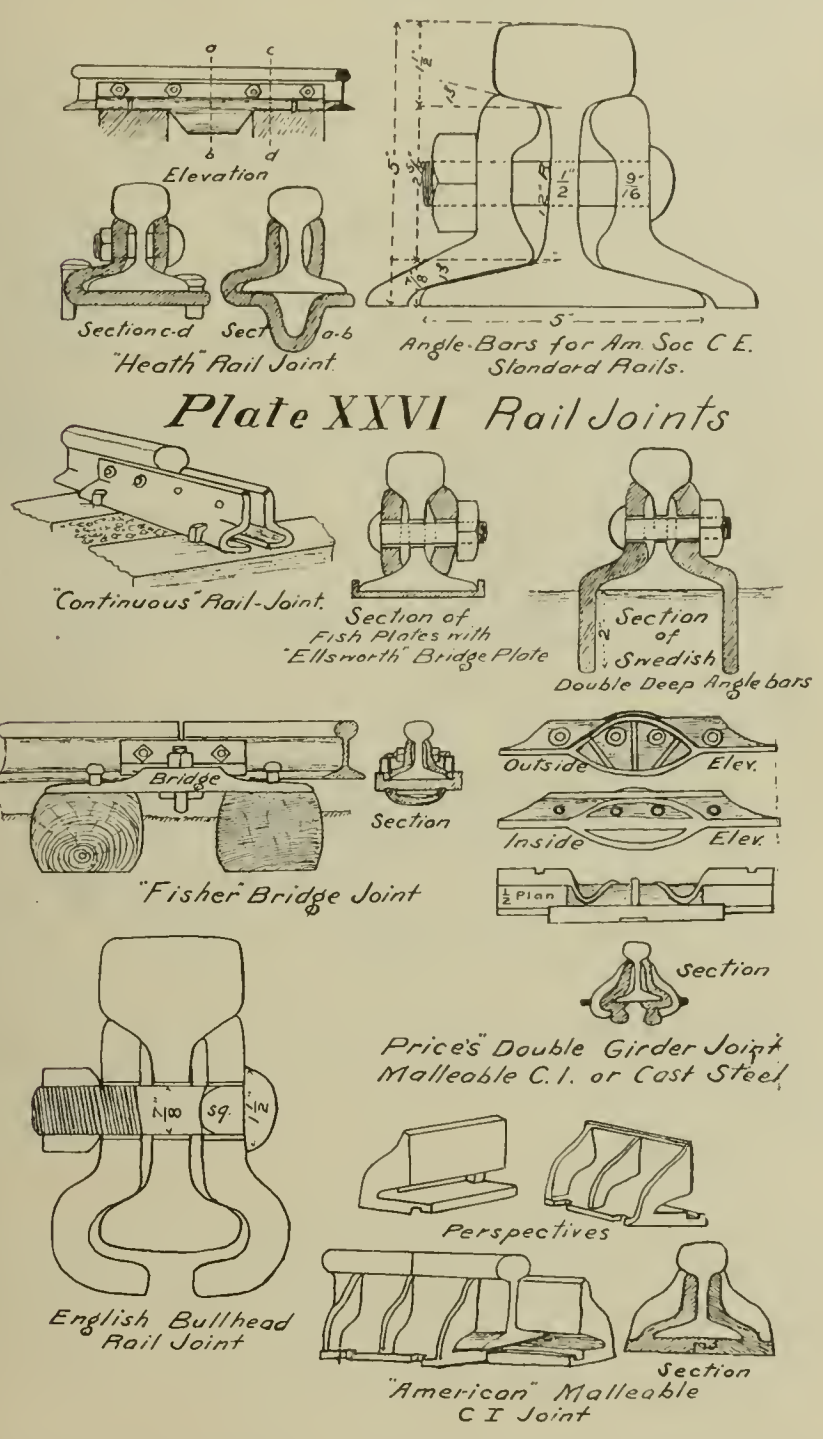
Under wear the top surface of a rail head gets more or less cold-rolled and brittle for about $\frac{1}{32}$ inch, which is the cause of heads breaking downwards (e.g.) a broken wheel may hammer and cause the brittle layer at top to crack, and the crack will continue on down until the rail breaks. High stiff rails with a broad head are more needed

as the wheel loads on drivers get greater, so as to keep a decent track and prevent cold rolling. (Large drivers are not so hard as small ones on track.)

The endeavor is to get a high carbon rail and work it until it is tough and compact in texture in the head.

ARTICLE 5.—RAIL JOINTS.

While great progress has been made in the strength and rigidity of rail joints, they can hardly be considered yet equal to the criterion of simplicity, and of being as strong as the rail itself, and as stiff laterally. Sandberg, by watching the effect of trains on narrow notches cut in



the heads of solid rails, concluded that the lipping down was due to lack of support of the fibres, and that we may, therefore, not expect to ever obtain a joint so perfect as to prevent this wear entirely. Various joints are shown on Plate XXVI., and also special ones attached to rails on Plates XXIII. and XXIV. Of these the simple fish plates were considered sufficient in early railroad days, when wheel loads were light and speeds not excessive, but, as these increased, the joints could not be kept in surface, and a lower flange was added, giving us the angle bar, which is the ordinary standard form to-day. It is simple, easily attached, etc., and may be used as a suspended joint on two ties with four bolts, or a longer one (44 inches), with 6 bolts, is often used, resting on three ties, and although more expensive, gives better results.

A comparison was made in Sweden between :

(1) Fish plates with Ellsworth base plate.

(2) Angle bars.

(3) Double deep angle bars with 2-inch extension downward between the ties.

The renewals for flattened ends in five years were (1) $6\frac{4}{10}$ p.c., (2) $14\frac{4}{10}$ p.c., (3) $17\frac{6}{10}$ p.c., but as for stiffness they were (1) $\frac{1}{3}$, (2) $\frac{2}{3}$, (3) 1. So that Nos. (2) and (3) were considered superior, particularly owing to their simplicity, but as No. 3 was easily heaved by frost and snow it was considered suitable for milder climates, and the choice rested on the angle bars.

The Fisher bridge joint has been tested quite extensively, and is found to be very stiff vertically, but weak laterally, and its various parts are rather expensive and more complicated than the angle bars. For these reasons it is not likely to find extensive favor. The Churchill joint of N. & W. R. R. is probably the most efficient joint yet designed as far as stiffness, etc., and is intended for use with 60 ft. rails. Otherwise it would be too expensive and complicated for ordinary use. The other joints shown appear to have good points, but are of less tried merit. (Also see *Engineering News*, page 178, Vol. I., 1891, for Paterson rail joint.)

We may expect, ultimately, to obtain a joint as strong as the rail itself, but how simple it can be made is for the future to show.

ARTICLE 6.—RAIL FIXTURES, ETC.

The weak spot of our track is its attachment to the ties by ordinary track spikes. Their heads are often cracked by excessive driving, re-spiking is frequent, and the ties get split and rotten much sooner than they would naturally, and while Greer, Goldie, curved, interlocking and other special spikes are improvements on the dog spike, yet the final solution would seem to be in some positive fastening such as wood screws or fang bolts, such as are used to hold rail chairs to the ties on British roads, and while tie plates and selected oak ties are keeping off the evil day, yet as speeds get higher and engines heavier, demanding a high stiff rail, this must be done by heavy traffic roads sooner or later, either with wooden ties and tie-plates, or with steel ties and bolts.

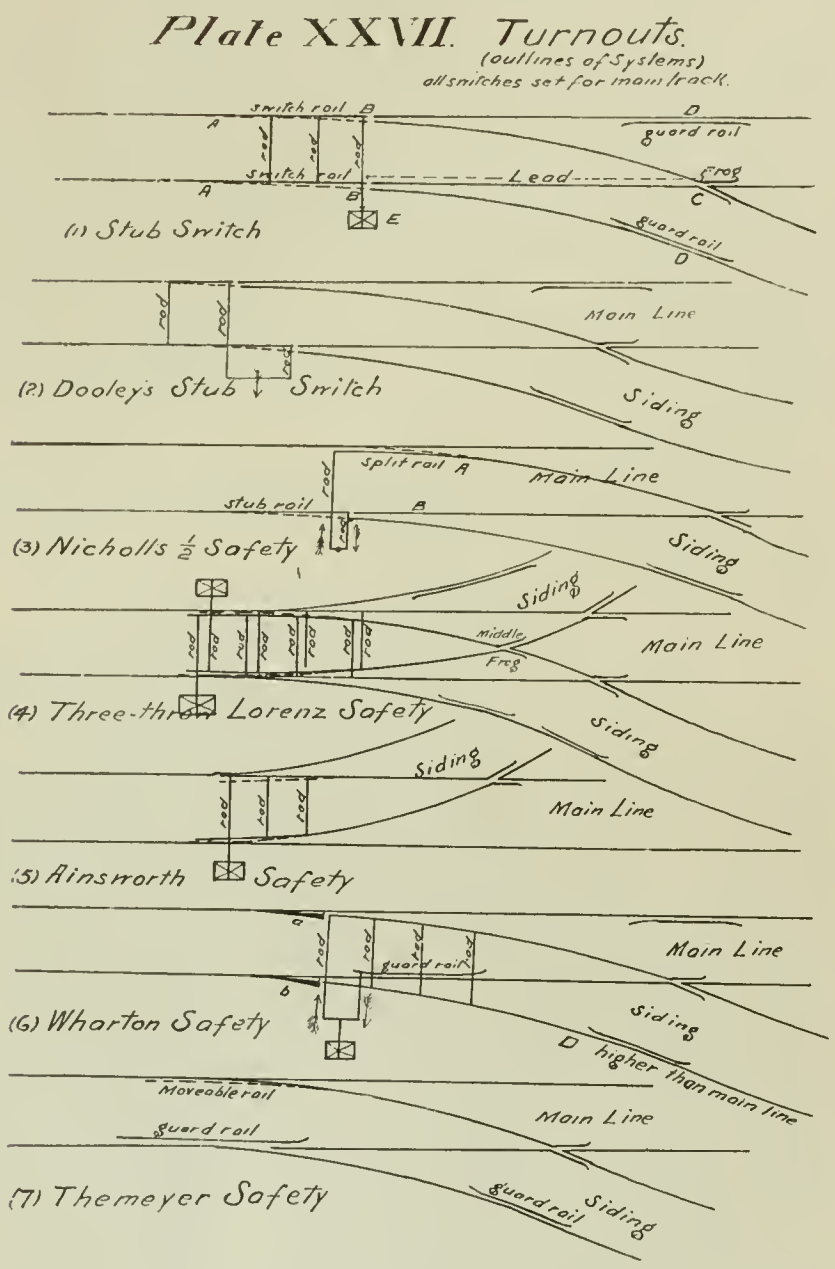
Tie plates (such as Goldie, Servis, Standard, Sandberg, etc.) will enable roads even with heavy traffic to use soft wood ties and a high stiff rail with narrow base (see N. Y. C. & H. R. R. R. section), and will prolong the life of ties. They are being adopted rapidly, some roads using them on curves only, others for the whole track. Wood screws for holding track are of steel, seven inches long, with thread for $4\frac{3}{4}$ inches, $\frac{3}{4}$ inch diameter, and have a pulling resistance of about six tons. Fang bolts are attached by boring holes through the ties, and screwing the bolts, which have heads on them suitable for holding down a rail, into a nut, with a fang on it. This fang grips into the wood on the under side of the tie, which prevents it turning or loosening.

The vibration caused by passing trains would soon loosen the ordinary nut on the bolts which fasten the angle bar joint to the rails, and, in order to prevent this, many devices have been tried. The double nut is not effective. A gravity lock outside the ordinary nut in the form of an eccentric nut is much better, and Young's patent has been used quite extensively, but the spring nut lock, which consists of one turn or a little more, of a strong steel spiral, with two cutting lips taking hold of angle bar and nut as the nut is screwed on, on top of the nut-lock, is the kind generally used, and being simple, cheap and effective, is likely to remain the favorite kind in use.

ARTICLE 7.—SWITCHES AND FROGS.

Outlines of various designs for passing a train from one track to another are given on plate XXVII., but of course there are various forms of attachments differing in detail only.

(1) The Stub switch consists of two movable rails, A B, with the ends B supported, and free to slide on plates for a lateral distance of five inches, called "throw." These switch rails or points are from 10 to 25 feet long, depending on the frog distance, B C, and the angle of the frog C. The guard rails, D D, prevent derailment at the



throat of the frog. The stub switch works for a three-throw as easily as for a two-throw turnout, and can be made into a safety switch (see Cook Switch, Plate XXVII., and Dunn Switch, *Engineering News*, Vol. II., 1890, page 174), and is considered to be more durable and easily kept in working order with snow and ice than are the many forms of split rail switches.

(2) Dooley's stub switch is a modification which makes easier riding by having one point longer than the other, substituting two jolts for one severer one, but it is not as rigid as the ordinary stub switch.

(3) Nicoll half-safety switch is a compromise between the stub switch and a split or Lorenz switch. It is not at all a strong or secure switch, as the two rails are not opposite each other. Its advantages are not very obvious.

(4) Lorenz safety switch is the model of various split switches. Both rails are feathered down so as to fit close up against solid rails. One is a main line rail, the other for the siding, connected so as to act together. This switch is adapted to position where the traffic is considerable on the branch line, or turnout, and in climates not troubled with ice or snow, but the split rails or points wear out rapidly, and it is more complicated when applied to three-throw turnouts, necessitating two sets of switch rails, stands, etc., set one ahead of the other, in which case neither of the main line rails are solid. The Stewart switch (*Engineering News*, Vol. I., 1895, page 59) has a special feature in making the switch rails by bending over solid-headed rails, instead of planing them down to a point. It is claimed this will give durability and rigidity.

(5) Ainsworth safety switch is made by giving the solid siding rail a sharp bend or recess, and the corresponding switch rail is left square ended, thus providing a more solid track for the main line, and a more durable switch rail. This form is adapted to branch lines having little traffic.

(6) Wharton safety switch is used for heavy main line traffic. It gives a solid main track. The siding rails lead the wheels onto blocks (a.b.) higher than the main line rails, and fall down on to the main line, while in facing the switch the wheels are first lifted by the blocks (a.b.) and then carried over the main line rails by the wheel tread riding on the high rail D.

The Macpherson switch (Plate XXVIII.) is a modified Wharton coming into use on the Can. Pac. Ry. The main line is solid, and the train is thrown onto the siding by having the outside movable rail higher than the main line, and a movable guard rail which is also higher than the main line, but which is thrown into position only when the switch is set for the siding. This design also includes a special form of frog, which is a sliding plate brought into position by means of bell-crank levers and rods operated from the switch stand, when set for siding; when set for main line the plate is clear of the main line, leaving the main line solid at this point also. This design has been in use since 1892, and it has proven itself very satisfactory and durable.

(7) The Themeyer safety switch has one movable split rail, and a stationary split rail or half-frog and guard rail. The movable rail and guard rail guide the wheels onto the siding when set for it. It is successfully used on the B. & O. R. R.

The main object of safety switches is to make it safe for a train to trail through a switch from the siding, when it is set for the main line, or vice versa, and this is accomplished, with split switches, by using springs which allow the movable rails to be forced aside just enough to pass the wheel flanges through. The springs then force the switch points back to the position for which the stand and signal are set.

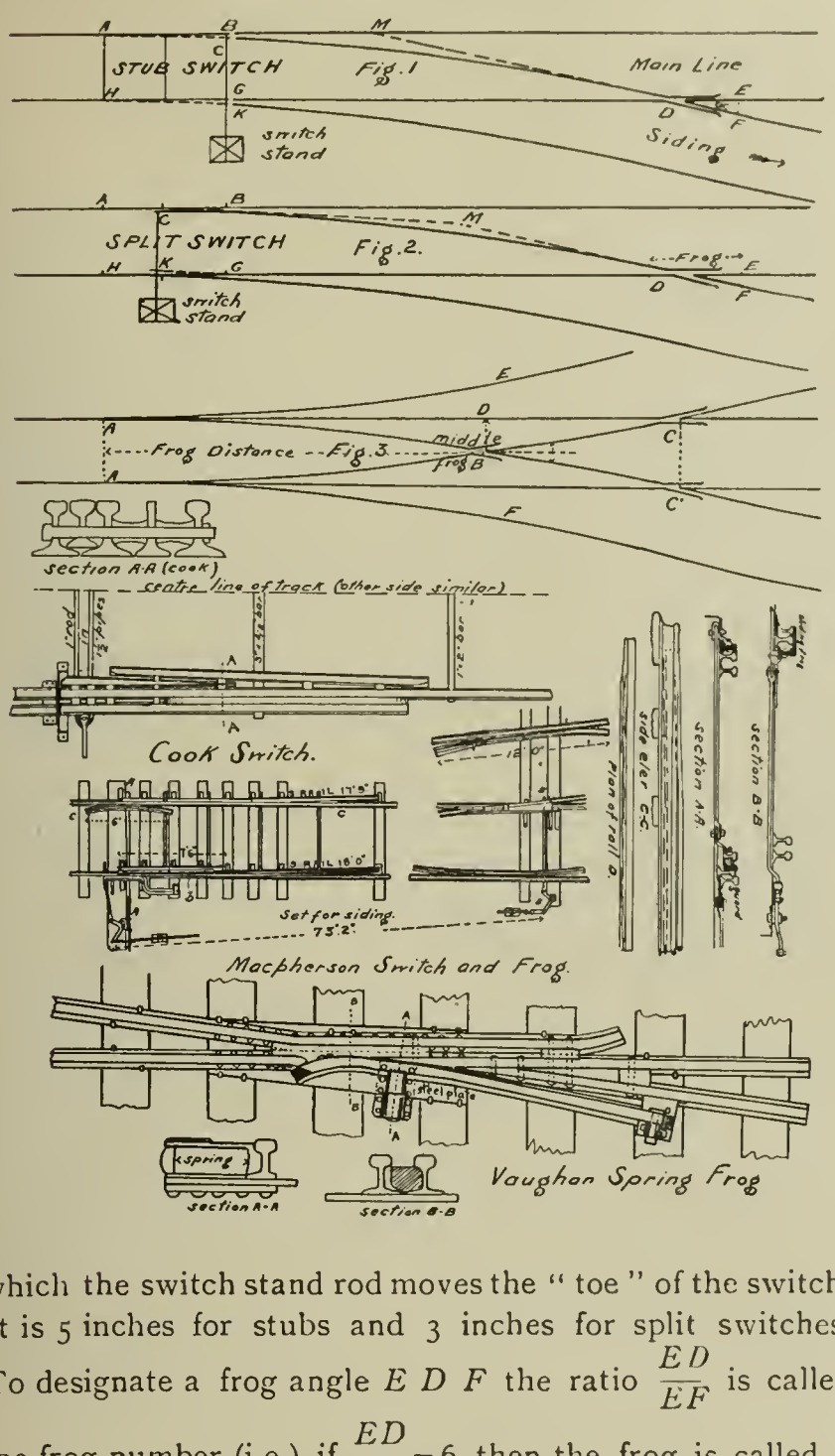
Other special switches of tried merit are the cam automatic, in which the split rails are fixed, and the solid ones move horizontally (see *Eng. News*, vol. I., 1890, page 489), and the Duggan switch, which has two knuckle-jointed vertical moving split rails. (See *Eng. News*, vol. I., 1893, page 390.)

Frogs.—Formerly cast steel solid frogs were common, but as they were more liable to crack, and when worn in one part were unfit for use, they were soon supplanted by frogs made up of pieces of steel rail fitted and bolted together onto a flat steel base plate—any worn part can be easily replaced. Such solid or stiff frogs are in most general use, but on main lines having heavy traffic, those turnouts with light traffic are now generally fitted with spring frogs (see Plate XXVIII.) in which either the "point" or the guard rail are movable, and the main line is normally a solid track. A train to or from the siding forces the frog open momentarily, and a spring brings it back again as soon as the train has passed, leaving the main line again solid. The defect in many of these spring frogs is the tendency to derail wheels with worn treads and flanges, by forcing open the spring frog when a train is on the main line. It is claimed that the Vaughan spring frog, used on the Penn. R. R., overcomes this difficulty by blocking up the tread. Other spring frogs of special features of merit are the Monarch, Ramapo and Pegram, described in the *Engineering News* since 1890.

Turnout Calculations.—The "lead" is the distance

K D (Plate XXVIII.) from the switch stand to the frog point. The fixed end of switch rails is the "heel," and the movable one the "toe." The "throw" is the amount

Plate XXVIII.



which the switch stand rod moves the "toe" of the switch. It is 5 inches for stubs and 3 inches for split switches. To designate a frog angle $E\ D\ F$ the ratio $\frac{ED}{EF}$ is called the frog number (i.e.) if $\frac{ED}{EF} = 6$, then the frog is called a No. 6, the ordinary numbers in use are 8, 9, and 10 for main lines, and 5, 6 and 7 for crowded yards and sidings. The middle frog is a special one, derived from the others by calculation or from a large-scaled plan:

(1) To calculate the lead from the frog number we have (see Wicksteed, Trans. C. Soc. C. E.) $D\ M$ (Fig. 1.) $= \frac{\text{gauge}}{\sin \alpha}$ or approximately $A\ D = \frac{2 \times \text{gauge}}{\sin \alpha}$ but, for small angles $\frac{1}{\sin \alpha}$ = frog number = N and gauge = g = 4·75 ft., approximately, then frog distance = $2.\ g.\ N = 9{\cdot}5\ N$ ----(A).

(2) *To find the length of the movable rails.*—Offsets to a circle from a tangent vary as the square of the distance from tangent point, and taking gauge as 57 inches and throw as 5 inches we have

$$\frac{\text{slide rails}}{\text{frog distance}} = \sqrt{\frac{5}{57}} = \frac{3}{10} \text{ approx. } (B)$$

also, for stub switch, lead $= \frac{7}{10}$ frog distance (C) which equations give all necessary data for a simple turnout for a stub switch. The frog for a very short distance is straight, and the slide rail is often practically straight, but by using a long rail and spiking the fixed portion, the movable part will bend to a curve.

If split switches are used Fig. 2 will apply, and the movable rail being, necessarily, straight, is from B to C only, is tangent to the circle at B, and is half as long as a stub switch movable rail, also in this case the switch stand is at a different place $K.\ C.$ and we have

Switch rail $= \frac{1}{2} \times \frac{3}{10} = \frac{3}{20}$ frog distance (D).

Lead = frog distance $- A\ C = \frac{17}{20}$ frog distance (E).

EXAMPLES.

(a) Stub switch No. 8 frog—

Frog distance $= 8 \times 9{\cdot}5 = 76$ feet by (A).

Slide rail $= \frac{3}{10} \times 76 = 22\ \frac{8}{10}$ feet by (B).

Lead $= 76 - 22\ 8 = 53\ \frac{2}{10}$ feet by (C).

(b) Split switch No. 9 frog—

Frog distance $= 9 \times 9{\cdot}5 = 85.5$ feet by (A).

Lead $= \frac{17}{20} \times 85.5 = 72.6$ feet by (E).

Slide rail $= \frac{3}{20} \times 85.5 = 12.9$ feet by (D).

NOTE.—These distances can be varied by a small percentage without affecting the running of the trains.

(3) Middle frog calculations, Fig. 3, Plate XXVIII. First let the two turnouts $AE\ AF$ be of same degree of curve and start from same switch stand, then $\frac{AD}{AC} = \sqrt{\frac{1}{2}}$ or $A\ D = \frac{71}{100}\ A\ C$, which gives us the middle frog distance from the frog distance AC, which equation (A) determines.

Also for small angles the angle of the middle frog will be $2 \times \frac{71}{100}$ frog angle at $C = 1.42$ frog angle C, and the number of the frog will be $\frac{1}{1.42} \times$ frog number $C = {\cdot}703$ frog number C.

Second, let the turnouts be of different sharpness, and let one begin say 6 feet ahead of the other, let the right hand turnout start first and be a No. 8 frog, and the left hand one a No. 10 frog. Call the middle frog distance x.

The two turnout frog distances are

$8 \times 9{\cdot}5 = 76$ feet, and $6 + 10 \times 9{\cdot}5 = 101$ feet.

Offset from one tangent to $B = \left(\frac{x}{76}\right)^2 \times 4{\cdot}75$ ft.

" " other tangent to $B = \left(\frac{x-6}{95}\right)^2 \times 4{\cdot}75$ ft.

But both offsets added = gauge = 4.75 ft., therefore

$$\left\{\left(\frac{x}{76}\right)^2 + \left(\frac{x-6}{95}\right)^2\right\} 4{\cdot}75 = 4{\cdot}75$$

and solving this quadratic equation we get $x = 61{\cdot}6$ ft. Also we can determine its lateral position by substituting in either of the above equations this value of x, in this case these are 3.13 ft. and 1.62 ft. The angle of the middle frog, in this case, can be calculated thus:

Middle frog angle $= \frac{61\ 6}{76}$ angle of No. 8 frog $+$

$\frac{55.6}{95}$ angle of No. 10 frog.

In crowded yards and with split switches these conditions prevail, and many much more intricate calculations are often needed when the turnouts are from curves, and cross other tracks which are also curving, but these can often be best obtained by carefully drawn plans to large scale.

MONTREAL'S TAXATION.

The ratepayers of Montreal find the present taxation of the city none too easy to be borne, and are constantly threatened with increases. The majority of the electors in the city do not feel a serious responsibility in the matter of the city's finances, being chiefly tenants or holders of small properties which bear a very low valua-

tion. They do not therefore check the extravagance and recklessness of the city council, which are flagrant. The only recourse of the more economical portion of the people is to the Legislature at Quebec, many of whose members are not prepared to deal with questions of the magnitude which Montreal's money affairs assume. There has therefore existed hitherto a free expenditure of money, a large part of which never reached the objects for which it was voted, and a constantly growing civic debt for whose payment no means exist if the city is to be maintained in a habitable condition. The city council is constantly looking for fresh subjects for taxation because the limit of the borrowing power has been already reached on the present assessment. At the last session of the Quebec Legislature the city charter was revised and all machinery was expressly made taxable. This has raised a storm among the owners of plants in Montreal, meetings have been held and most vigorous protests made. Some of the leading manufacturers have spoken very plainly on the subject of their removal to more advantageous locations if the tax is imposed. Those who had the charter amendment in charge explain that the city has always had power to tax machinery under the head of "immovables," and the present clause was framed so as to make taxable the wires, rails, etc., of the electric companies which are at present exempt as not being attached to the property of the assessed.

While this explanation shows that the city council has no present intention of placing a tax on manufacturing plants, yet the existence of the clause is a constant menace to the manufacturers at present within the city limits, and a deterrent to others establishing themselves there. It will build up the small towns surrounding the city, and will be an incentive to those bonus-offering towns like Sherbrooke, Que., or Bellevilie, Ont., to grant inducements to secure the taxed industries. A manufacturer who is heavily taxed on his machinery to raise funds for street paving which is not put down (that is the method in Montreal) is apt to look longingly to towns where there are no taxes on machinery and a large cash bonus is available for buying new plant.

AN ALIEN ENGINEER.

St. Mary's, Ont., had been discussing waterworks systems for two years, but little progress had been made until early last month. Committees of the town council and board of trade had collected some information from other towns, and a public meeting had been held at which some of these had been read. A civil engineer from the United States who happened to be passing through (it is reported in the local papers) stopped off for a few hours, drove round the town with the chief officials and was instructed to prepare plans of a water supply system for the town. The engineer in question is of unquestioned ability, and has constructed some very large works in the United States with a great deal of success, but it would seem almost unfair to Canadians that an alien engineer should be employed upon the mere offer of his services without considering the claims of the many successful members of the profession who have done good work in Canada and depend upon Canadians for the substantial recognition of that work which will enable them to remain in Canada and follow their chosen profession.

INDEX.

The Index for Vol. 6, THE CANADIAN ENGINEER, is now in course of preparation, and will be mailed to subscribers on application.

ENGINEERING WORKS UNDER GOVERNMENT INSPECTION.

There is a well-grounded prejudice in Canada in favor of the freedom of municipalities in the carrying on of local affairs. We have been accustomed to count our municipal freedom as one of the choicest growths of the freer air of the American continent, and to complain strongly against anything tending to strengthen the central Government at the expense of the outlying centres of authority. But in spite of preconceived notions we must admit that "they do some things better" in Great Britain. We require in Ontario a closer supervision by the Government of public works undertaken by the municipalities.

In Great Britain the Local Government Board has control of all public works such as water supply, sewage disposal works, etc. When a town decides to construct a work the plans are submitted to the Board and are passed upon by engineers whose standing in the profession makes their decisions irreproachable, both morally and scientifically. If the decision is favorable to the proposed work the town is authorized to borrow the necessary funds and carry on the work according to the plans submitted, and the inspectors of the Board see to it that the plans are not departed from nor any work not in accordance with the specifications as passed upon, put in. The consequence of this is that the British local public works are of unrivalled excellence, and the municipal indebtedness is low. In Ontario any clique of aldermen or town councillors who get together may decide upon a public work, talk the citizens into adopting it, hand over its execution to the individual whose arguments appeal most strongly to the aldermanic mind, and so add almost at will to the public debt. It is true that an issue of municipal bonds requires to be approved by the Local Legislature, but it is the issue of bonds that comes in for the criticism of the legislators, not the economical spending of the resulting moneys. Even if the plans were required to be passed by the Private Bills Committee there would be no improvement, for the legislators know very little more engineering than do the aldermen.

A supervisory board of civil and sanitary engineers of the highest standing is needed to act as a check, as does the Local Government Board in Great Britain. We would not then have unsatisfactory works constructed at absurd expense by municipalities unable to carry the resulting debt. This is true in too many cases in Ontario to-day.

SOME INCIDENTAL BENEFITS FROM THE GROWTH OF FORESTS.*

Mr. Chairman and Gentlemen—On considering the true meaning of the title of my subject it has occurred to me that what is the main and what the incidental benefits of forest growth to the community depends largely upon the point of view. The guardian of the public health would probably have no doubt that the principal use of forests was to purify the air by absorbing carbonic acid gas and exhaling oxygen and in regulating the temperature. The scientific agriculturist would be inclined to think that the chief function of a forest was to serve as a windbreak and shelter for farm crops, and assist the subterranean irrigation, while the old-fashioned farmer will be equally certain that the only use of trees is to furnish fuel and fencing, and they should only be grown so long as they are cheaper than substitutes, failing in this they should be cleared off to provide pasture or ploughed fields. The engineer will be inclined to regard trees growing in mass to be chiefly valuable as a regulator of stream flow

*From a paper read before the Association of Ontario Land Surveyors.

and a flood preventative, while the artist will look at them mainly from an æsthetic point of view, as making or marring the landscape, according to their presence or absence and thereby contributing to the sum total of human happiness.

Many land surveyors, I have no doubt, frequently have occasion to regard a forest as an unmitigated nuisance, especially when it is composed of Ilex verticillata, or black alder, and lies in the line of march. As an official of the Government, interested in maintaining the provincial revenues from sources remote from direct taxation, I have to admit that my own point of view is largely a utilitarian one, that regards the forest as a source of wealth to the province and to the people, but I fully recognize the importance of the other, and what I shall call the incidental benefits, benefits so great and so important to the general welfare of the community as to make it desirable that forestry should be an affair of the State rather than of individuals, with whom present financial necessities may cause a sacrifice of future profits and result to the detriment of climatic conditions.

Before going into the matter of the incidental benefits of forest growth, allow me briefly to refer to what I consider the main question from the standpoint of provincial revenue, and the maintenance of the extensive industries dependent upon forest products. The provincial revenue received last year from woods and forests by way of ground rent and timber dues was over $981,000. This represents the production of a large amount of timber, and if we add to this the large quantity of firewood, railway ties, pulpwood and about 375,000,000 feet of timber cut yearly on lands not controlled by the Crown, it will be seen what a very important part in the industrial life of this province is played by our forests and their products. The number of men employed in the woods, on the streams and in the saw-mills, apart altogether from those engaged in other industries dependent in part or wholly upon the forest, runs into the thousands, while the capital employed represents many millions.

It is not necessary for me to go into the many reasons why permanent forest industries must be dependent largely upon State control, that is I think pretty well understood by everybody now-a-days, but I desire to point out what the present forestry policy of the Government means to the future revenue, and the industrial life of the province. The Forest Reserves Act of 1897-8 proposes to set apart areas of non-agricultural lands to be withdrawn from settlement and kept permanently the property of the Crown for the purpose of growing successive crops of timber. If these areas had to be cultivated and planted to young trees, at an expense of about $15 an acre, the amount of money required would be very great, and if the amount thus expended, with interest, were added to the annual cost of care and protection of the young trees, it is doubtful if the resultant crop would show a very large profit on the transaction. True, the crop would be larger than in a forest grown under natural conditions, as was the one we are now harvesting, and a shorter time would be required to enable it to reach a state when it would be profitable to cut it. At the same time the initial expense and annual charges would be so great as to render the project of doubtful financial success on any large scale in this country, where only the more valuable products of the forest have a market value.

Fortunately for us, however, this is not necessary to provide future crops of trees and of the sorts experience has proved to be the most valuable. To do this will require the expenditure of very little money, but more time. I hesitate to make any remarks as to how we are fixed in the former commodity—it is more or less a political subject, on which doctors differ—but we are rich in the latter. How much money we can invest in reforesting without borrowing I will not attempt to say, but we have plenty of time. The nation never dies, or hardly ever, and we are a young nation, with millions of acres of land valuable for growing trees, of little value for any other purpose, so we can afford to wait to allow nature to restore the magnificent forest removed by axe and fire from these lands. And nature is already doing the work, not as evenly as we could wish, nor with a crop of pure white pine, our most valuable tree, but she is doing the work just the same. I had occasion this past summer to examine a tract of several thousand acres that had been lumbered over, and burned over several times. Over this tract I found a vigorous growth of poplar, birch, white pine, red pine, tamarack, cedar, maples and other trees. In some places there was very little pine, but over most of it there is a crop of pine numbering from 200 to 700 trees to the acre and growing very fast. Much of it is now 6 to 9 inches in diameter, and I estimate that in 50 years there will be a very heavy crop of pine ready to cut, not less than 50,000 feet B.M. to the acre. I do not mean that it would be wise to cut that much at that time, but it could be cut.

On much of the abandoned farm lands in New England 50,000 feet to the acre is now standing, and two years ago the Rathbun Co. cut 100,000 feet to the acre over quite a tract in Grinsthorpe. I mention this to show that my estimate is not excessive. The stumpage value of that pine 50 years from now will be worth not less than $4 per M, and is likely to be worth more. At this figure the pine timber on much of this land fifty years from now, if protected and cared for, will be worth $200 per acre, which represents a present cash value at 3 per cent. compound, of $45.62 an acre, and this land is generally considered of no value.

The main benefit to be expected from these reserves consists in the provincial revenue, and the maintenance of industries dependent on them, but in addition to this the incidental advantages from the presence of these masses of trees are of vast importance to the people of this country. Concerning these factors in forest value there is room for considerable diversity of opinion, and this diversity exists. It is claimed by some forestry advocates that forests materially affect the rainfall, while on the other hand, it is claimed that it is not so, but that the rainfall affects the forests. While there can be no doubt of rainfall affecting the forests, it is not equally certain that the presence of forests influences the amount of rainfall. It is a case of not proven, although to my mind the evidence mainly goes to show that if the total rainfall is not influenced by tree growth its distribution is. We know that trees take up immense quantities of water from the soil and transpire most of it through the leaves. The moisture thus transpired from a large hardwood forest is very large, though difficult to estimate accurately, as the amount varies with the thickness and number of the leaves, amount of water in the soil and other conditions. A conservative estimate is made by F. B. Hohnel, a German scientist, of a fifty or sixty-year old beech forest for the season of growth at 1,972,000 lbs. or 986 tons of water per acre. Some authorities make the amount much larger than this, but in any event there is sufficient to lead one to believe that the atmosphere immediately above a forest must be so charged with moisture as to hasten precipita-

tion in clouds that may come in contact with it. That forests exercise a beneficial influence on the climate of the neighborhood there can be no doubt. The temperature of the air in the forest is cooler during the day and warmer during the night than in the open field. Consequently air currents are set in motion by this difference in temperature, cooler currents coming from the forest during the day in the lower strata and warmer air during the night from the upper strata, thus equalizing the temperature and increasing the humidity of the air. This is aside altogether from the mere windbreak action of the forest, which is of considerable importance.

The aspect of forest growth most likely to appeal to the members of this association is its effect as a regulator of our water supplies, and a factor in flood prevention. Even here there seems to be a difference of opinion, and a Western States writer a short time ago claimed that the presence of forests in the mountains prevented the snow from drifting into immense banks and then gradually thawing all summer, keeping up a constant supply of water for the streams. Without disputing this statement—for it cannot possibly apply to our own province, which is not mountainous—I may state as an accepted fact that the main factor in our great wealth in water powers and navigable waters are the great forests. At the risk of repeating what you may already know better than I, I desire to point out some ways in which the forests serve to regulate the flow of streams and prevent alternate flood and drought. Speaking generally the steam flow can only reach a percentage of the rainfall in the catchment basin. If the water does not fall either as rain or snow there can be no streams; but granted a certain precipitation during the year it may be gradually given off to the streams, making them reasonably constant in volume, or it may run off quickly, causing a flood and subsequent drought. Our streams are fed in two ways, by underground springs, and by the run off from the surface of rain or melted snow. Springs occur generally where a layer of porous sand or gravel lies between an impenetrable subsoil and the surface soil. The rain water runs under this top soil through the sand or gravel, and as it cannot penetrate the subsoil it is forced out through an opening in the top soil and goes to add to the volume of the nearest stream. It will readily be seen that a larger quantity of water will reach the grave layer if the surface is covered with forest than would be the case in the open field, as most of it would run off the surface after rain, in the latter case instead of soaking into the soil. Most of us have known of springs that have become dried up in the summer, that years ago before the woods had been removed were perennial.

In the same way the forest serves to regulate the water running from the surface into the streams. Concerning the extent of this action of the forest a great deal has been written pro and con, and volumes of figures have been compiled to show that the removal of the forest had little or nothing to do with stream flow. At the same time I think we are all pretty well convinced that Captain Eads, the famous engineer, was right when he remarked concerning the building of the jetties at the mouth of the Mississippi River, that he was working at the wrong end of the stream. The very nature of a forest floor covered with small twigs, leaves and sponge-like soil, indicate the mechanical action that dams the water and allows it to run off slowly. Branches die and fall to the ground. Trees do likewise and in falling across something would form dams and create small reservoirs of water against the time when it would be needed. The sorts of trees also form conductors that allow the water to penetrate the subsoil deeply, and add to the subterranean supply. Remove these forests and the rainfall rushes off to the streams, which are soon in flood and soon dry up. The snow exposed to the full force of the wind and sun follows the same course, and large sums are being spent all over the continent to prevent the disastrous floods that now cause so much damage and loss of life, but which were not known in the earlier days when this was really a "wooden country."

At Brantford, I believe, they are spending a large sum of money to prevent the annual flood of the Grand River doing so much damage. It is worth noting that the county of Brant has only about 7 per cent. of its total area classed as woodland, and of this much is not tree forest land, but is pastured and the soil beaten hard. Most of you know something of the vagaries of the river at Belleville, which nearly every spring causes anxiety as to the amount of damage it is likely to do in flood, and in summer is so dry as to cause the remark by a traveler who saw it last fall from a Grand Trunk car that "it looked like a first-rate place to put a river in."

A concrete case of the effect of forest denudation on stream flow has been furnished by W. C. Caldwell, M.L.A. Mr. Caldwell is a lumberman and a mill owner, and as his business interests were affected, he made careful notes of the occurrence in his diary at the time. The watershed of the Clyde River was swept by successive fires in 1875-6-7, a large territory being affected. The water supply was gradually affected from 1880 to 1885. From 1885 to 1892 the flow of water was so reduced that in 1886-7-8 9 and 90 the mills on the Clyde were short of water in August and September, something unknown until that time. In the meantime the new crop of poplar, birch, etc., had reached quite a size, and in 1890 began to affect the water supply and restore the evenness of flow. Since 1893 there has been an abundant supply of water, and Mr. Caldwell has no doubt it is due to the effect of the new forest that has followed the fires. Failing this new forest a constant supply of water could only have been secured by a costly system of impounding reservoirs.

LITERARY NOTES.

The annual report of the Department of Mines, Nova Scotia, for the year ending Sept. 30th, 1898, contains 100 pages of facts and figures about the progress of mining in Canada's farthest East. Extracts from the report will be found on another page.

Canadian Hand-Book of Steam and Electricity is a volume of 150 pages in brown cloth, published by the C. H. Mortimer Co., Ltd., Toronto, contains a mass of valuable information, much of which is in tabular form and convenient for reference. A large portion of the work is of such an elementary character as to give it special value for beginners.

Accounts of the City of Charlottetown, P.E.I., and Annual Reports of the several departments of the City Government for the year ending the 31st Dec, 1898, embodies the report of the city engineer, Freeman C. Coffin, upon the system of sewage disposal for the city now being installed. We hope to refer to the special features of this system at a later date.

The Annual Report of the City Engineer of Hamilton, Ont., for 1898, contains among other interesting matter a large colored map, showing the proposed changes in the water distribution system. The expenditure on public works in the past year was $204,861.36. Full page illustrations are given of the new pumping station, the filtering basin, boiler room of the main pumping station, etc.

The Canadian Magazine for April contains an interesting chapter of Miss Wood's story "A Daughter of Witches" and a pleasant variety of short stories, together with the usual poetry. Judge Ermatinger continues his historical sketch of the Michilimackinac. It is unfortunate that this number, however, retains the dime magazine standard by publishing a variety of uninteresting pictures of more or less uninteresting theatrical persons.

The special Easter number of the Ironmonger issued March 25th, 1899, is one of the most successful special numbers that trade journalism has produced, The lithographed cover is a pleasing introduction to the three hundred and eighty pages of illustrated advertisements and general reading.

The Universal Electrical Directory (J. A. Berley's) for 1899' which is the eighteenth year of publication, contains in its 1,250 pages an amazing mass of most useful information. The index alone, to the classified trades, occupies four pages, which is a criterion of the thoroughness with which the ground is covered. It is difficult to think of an electrical trade question which cannot be answered by the aid of this well-named Universal Electrical Directory.

We have received A. S. Lovendal's Dictionnaire Technique Francais-Anglais des Outils et Ustensiles Employés dans les Metiers manuels, La Petite Industrie, La Ménage, etc. This is a most valuable dictionary for anyone who has to do in any way with the arts or trades among our French-speaking fellow citizens. The lists are most complete and are so arranged as to be most conveniently referred to, as not only are the different tools and apparatus listed alphabetically, but also each art or trade has grouped under it, as a heading, all the tools, etc., which naturally fall there.

The series of papers by Cecil B. Smith, Ma. E., which appeared in THE CANADIAN ENGINEER during the past two years have now been issued in book form under the title "Railway Engineering." There are many standard works written upon various phases of railroad construction, the merits of which are universally recognized, such as "Wellington's Theory of Location" and "Foster's Wooden Trestle Bridges," but Mr. Smith's work is the only general discussion of the entire subject that has recently been published and the work is therefore very welcome, especially to those who may wish to acquire a general knowledge of the subject before commencing a special study of any one of its details. The title "Railway Construction" would perhaps be more appropriate than that of "Railway Engineering" as the book does not deal with the important branches of track maintenance and operation. Mr. Smith's long and honorable professional career amply qualifies him to write as an authority upon his chosen theme, for he has been prominent in the locating and constructing staff of the Northern Pacific Junction, Niagara Central, Charleston, Cincinnati and Chicago, Roanoke and Southern, Baltimore and Ohio, and Canadian Pacific Railways, and had ample opportunity during his connection with McGill University to thoroughly study the theory and literature of railroading. His work therefore presents to the reader a concise and thorough description of the engineering side of railroad construction, and in detail is as follows: Chapter I. is devoted to railroad statistics, dealing more especially with those of Canada, and commenting particularly upon the maxims of railroading and the considerations technical, political and local which must be taken into account when studying any proposed line. In Chapter II. train resistances and their effect upon the cost of transportation are discussed, the methods introduced by A. M. Wellington in his "Theory of Location" being closely followed. This chapter is perhaps the most valuable in the book, for to-day no locating engineer can be considered as properly qualified who is not fully aware of the financial effects of grades and curvature. Chapter III. contains a brief reference to the use of circular curves and a clear exposition of vertical and transition curves. These latter may still be classified as recently introduced, for their use is by no means general to-day and the realization of their importance dates only from the first scientific study of the theory of location. The simple methods of calculation that are recommended nullify the objections on the ground of intricacy that are so often urged against them. In Chapter IV. the reader gets the benefit of Mr. Smith's wide experience in reconnaissance and field work, and the many practical hints given are of great value. Chapter V. is devoted to construction and treats of those structures that are usually under the superintendence of the resident engineer. It is plentifully illustrated with cuts of the standard plans of the various railroads with which the author has been connected and concludes with some very pertinent advice upon classification and estimation. Chapter VI. is a most unusual and interesting addition and contains a careful resumé of those clauses of the Railway Act that are of special importance to engineers. A brief second part upon track material concludes the work, but the collection of diagrams for the rough estimation of timber and masonry quantities from the profile are worthy of especial mention from their particular usefulness in the comparative study of locations. While the book as a whole is very welcome, dealing as it does with the entire field of the construction engineer, the chapters upon train resistances and railway law deserve the most especial commendation, because many of our engineers have simply grown into their profession and are ignorant of the great forces, natural and political, that control our common carriers. It is only to be regretted that Mr. Smith has not seen fit to discuss his interesting subject at greater length, for there is room at present for a successor to the once standard work of G. L. Vose, but as it is, it is to be heartily recommended to all who desire a clear introduction to the art of railroad building. Railway Engineering, Cecil B. Smith, Ma. E. Cloth, 200 pages, profusely illustrated. Biggar, Samuel & Co., Publishers. $1.50.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports into Canada from Great Britain of interest to the metal trades for the month of February and the two months to February, 1898 and 1899 —

	Month of February,		Two Months to February,	
	1898	1899.	1898.	1899.
Hardware	£1,629	£1,116	£3.333	£2 654
Cutlery	3.283	3,055	6,612	7,820
Pig iron	1,348	401	1,852	762
Bar, etc.	1,212	801	1,412	1,246
Railroad	6,872	..	6,922	..
Hoops. sheets, etc.	1,939	1,618	2,753	1.743
Galvanized sheets	542	332	2,518	820
Tin plates	6 586	5,862	18,515	11,547
Cast, wrought, etc., iron	1,998	1,443	3.571	2,440
Old (for re-manufacture)	80	..	80	..
Steel	6,106	1,919	10,627	5,689
Lead	594	133	1,518	1,022
Tin, unwrought	619	118	1.920	2,633
Alkali	1,383	853	2,884	2,396
Cement	1,389	35	1,874	248

SUMMARY OF THE MINERAL PRODUCTION OF CANADA IN 1898.

The following figures have been submitted by the Geological Survey of Canada to the Government, and are subject to revision:

Product.	Quantity.	Value.
	(a)	(a)
Metallic—		
Copper (fine, in ore, etc.) (b) lbs.	17,951,421	$ 2,159.556
Gold, Yukon district*	.....	$10.000.000
Gold, all other	.....	3.700.000
Iron ore, tons	58.161	152.510
Lead (fine, in ore, etc.) (c) lbs.	31,915.319	1.206.399
Nickel (fine, in ore, etc.) (d) lbs.	5.517.690	1.820.838
Silver, (fine, in ore, etc.) (e) ounces.	4.434.085	2,583.298
Total metallic	.....	$21,622,.501
Non-Metallic—		
Asbestus and asbestic, tons	23 785	486.227
Chromite, tons	2.021	24.252
Coal, tons	4.172.655	8.227.058
*Coke (f) tons	72.444	210.200
Felspar, tons	2,500	6.250
*Fire clay, tons	2.170	5.000
Graphite, tons	.....	11.398
Grindstones, tons	.....	39.465
Gypsum, tons	219.256	230.440
Limestone for flux, tons	33.913	31.153
Manganese ore, tons	50	1,600
Mica	.....	117.598
Mineral pigments—		
Baryta, tons	1.070	5.258
Ochres, tons	2.341	18.600
*Mineral water	.....	155.000
Moulding sand, tons	10.572	21.038
*Natural gas (g)	.....	320.000
Petroleum (h) bbls.	700.790	981.106
Phosphate (apatite), tons	733	3.665
Pyrites, tons	32.218	128.872
Salt, tons	57.142	248.639
Structural materials and clay products—		
Cement, natural rock, bbls.	87.125	73.412
Cement, Portland, bbls.	163.084	324.168
Flagstones	.....	4.250
Granite	.....	73.573
*Pottery	.....	135,000

Sewer pipe	.....	166,421
Slate	.....	40,791
Terra cotta	.....	167,902
Tripolite, tons	1,017	16,660
Building material, including bricks, building stone, lime, sands and gravels and tiles (estimated as for previous year)	.....	3,600,000
Total structural materials and clay products	.....	4,602,177
All other non-metallic	.....	11,282,419
Total non-metallic	.....	15,884,596
Total metallic	.....	21,622,601
Estimated value of mineral products not returned	.....	250,000
1898 total	.....	37,757,197
1897 total	.....	28,661,430
1896 total	.....	22,584,513
1895 total	.....	20,758,450
1894 total	.....	19,933,857
1893 total	.....	20,035,082
1892 total	.....	16,628,417
1891 total	.....	18,976,616
1890 total	.....	16,763,353
1889 total	.....	14,013,913
1888 total	.....	12,518,894
1887 total	.....	11,321,331
1886 total	.....	10,221,255

*Partly estimated.

(*a*) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(*b* Copper contents of ore, matte, etc., at 12.03 cents per lb.

(*c*) Lead contents of ores, etc., at 3.78 cents per lb.

(*d*) Nickel contents of ore, matte, etc., at 33 cents per lb.

(*e*) Silver contents of ore at 58.26 cents per oz.

(*f*) Oven coke, all the production of Nova Scotia and British Columbia.

(*g*) Gross return from sale of gas.

(*h*) Calculated from inspection returns at 100 gals. crude to 42 refined oil, and computed at $1.40 per bbl. of 35 imp. gals. The barrel of refined oil is assumed to contain 42 imp. gals.

In studying the figures given in the above general table, many interesting and gratifying features will be noticed. In the grand total an increase is shown of over $9,000,000 or nearly 32 per cent. as compared with 1897. This is a still larger proportional increase than that of 1897 over 1896 which amounted to nearly 27 per cent. Compared with 1886, the first year for which statistics were issued, we find an increase in the value of mineral products in thirteen years of nearly 270 per cent. When it is remembered that during the same period the increase in the population has been only about 14 per cent., it will be evident that the proportional importance of the mining industry to the country is very much greater than it was at the beginning of the period dealt with. Thus the per capita value of the mineral production of the country has increased from about $2.20 to $7.20. Whilst these large increases of late years have of course been partly due to the discovery and working of the rich gold-placers of the Yukon, other important mineral industries have also contributed to them, and there is every reason to expect a continued rapid growth in many of them for some years to come, especially as the province of British Columbia continues to develop. The following table shows the principal changes in the production and values for the year 1898 as compared with the revised figures for 1897:

Product.	—Quantity— Increase. Per cent.	Decrease. Per cent.	—Value— Increase. Per cent.	Decrease. Per cent.
Metallic—				
Copper	34.96	.....	43.81	.....
Gold	.....	.....	127.31	.....
Iron ore	14.70	.....	17.05	.....
Lead	.....	18.20	.....	13.63
Nickel	38.02	.....	30.14	.....
Silver	.....	20.23	.....	22.27
Non-Metallic—				
Asbestus and asbestic	.....	21.87	9.17	.....
Coal	10.21	.....	12.66	.....
Gypsum	.....	8.52	.....	5.76
Natural gas	.....	.....	.....	1.80
Petroleum	.....	1.28	.....	3.00
Cement	21.93	.....	44.43	.....

It will be observed that most of the large increase in the total is to be credited to the metals, gold, copper, nickel, the non-metallic materials, coal, asbestus and cement also contributing. Beginning with the most important, the increases in these products were as follows, viz.: Gold, about $7,673,000; coal, over $924,000; copper, nearly $658,000; nickel, nearly $422,000; asbestus, iron ore and cement aggregating about $185,000. Of the gold output the main feature was the very large increase in that of the Yukon. This accounts for $7,500,000 of the enlargement, which is three times as great an estimated output as that for last year. With the exception of the gold washings of the Saskatchewan River in the Northwest Territories, there were also increases in all the other districts of the Dominion. There were increased outputs of coal in all the different districts. In copper the largest increase was in Ontario, which amounted to over 50 per cent. of the previous year's output. British Columbia showed also a considerable enlargement, whilst in Quebec a small falling off was apparent. A rise in the price of the metal makes the proportional increase in value greater than that for quantity. In nickel, the increase in the quantity is greater than that in the value, owing to a fall in the average price of the metal for the year.

The falling away in the production of both lead and silver is, in the former case, partly offset by the rise in the average price, whilst in the latter case a lower price for the year has aggravated the proportional decrease in the value as compared with the quantity. Whilst there was a decrease in the actual quantity of the product of the asbestus mines of Quebec, the value shows a large percentage increase, which is explained by the lesser proportion of asbestic and low grade fiber in the output. The proportional contributions of the chief products to the grand total of value are set forth in the following table both for 1897 and 1898:

PRODUCT AND PER CENT. OF TOTAL PRODUCTION

1897.		1898.	
Coal	26.87	Gold	36.28
Gold	21.02	Coal	21.79
Building material	12.56	Building material	9.53
Silver	11.59	Silver	6.84
Copper	5.24	Copper	5.72
Nickel	4.88	Nickel	4.82
Lead	4.87	Lead	3.19
Petroleum	3.53	Petroleum	2.60
Asbestus	1.55	Asbestus	1.29
Natural gas	1.14	Cement	1.05
Cement	96	Natural gas	85
Gypsum	85	Salt	66
Salt	79	Gypsum	61
Coke	62	Coke	58

With the exception of the transposition of the positions of gold and coal, of natural gas and cement, and of gypsum and salt, the items stand in the same order as before. The feature mainly noticeable is of course the assumption of the first place by gold, and its large predominance over the rest. To this is largely due the fact that the metallic minerals as a class contributed in 1898 over 57 per cent. of the whole, as compared with about 48 per cent. last year. The structural materials amounted to about 12 per cent., and the other non-metallic minerals to about 30 per cent.

BOSTON SEWAGE OUTFALL.

BY CHARLES E. TROUT.

For THE CANADIAN ENGINEER.

More than one-half the sewage of Boston and vicinity is discharged into tide water at Moon Island, about six miles from the main water front of the city. To reach this point the sewage flows by gravity to a pumping station on the harbor front near Moon Island, where it is raised about thirty-five feet and forced through a tunnel under an arm of the harbor to the outfall works. These consist of a storage reservoir, together with the necessary gate houses and machinery for filling and dis-

charging. The function of the reservoir is to store the sewage while the tide is flowing in and discharge it after the tide has turned, when the strong current carries it out to sea. The reservoir is composed of four distinct basins, so arranged that one may be kept empty for any purpose, as cleaning or repairs, while the others are in use. The four basins are of nearly equal capacity and the division walls between the basins are of rubble on concrete foundation. Where the foundation rests on gravel or other pervious material a line of tongued and grooved sheet piling is driven into the clay underlying such material. As a further precaution against water passing under the division walls and the bursting of the reservoir floor by springs, a line of drain pipe, with open joints, is laid on either side of each division wall, and beneath the floor of the basin. These drains discharge outside the reservoir. Thus, water accumulating beneath the floor finds free access to the drains, and is carried safely outside the reservoir. A safety valve, opening into the reservoir is provided on each drain to relieve an excess of pressure below the floor in event of a drain being choked. The floor of the reservoir is of concrete nine inches thick, and is shaped in alternate gutters and ridges, the width centre to centre of ridges being twenty feet. Set in the ridges at intervals of thirty feet are blocks of granite, three feet square and eighteen inches deep, to be used as pier stones in case it should ever be necessary to roof the reservoir.

The arrangements by means of which the reservoir is filled and emptied could best be illustrated from a figure. Across the lower end of the reservoir runs the outfall sewer, which brings the sewage from the city to the works. Immediately below it are the discharge sewers, which carry the sewage from the reservoir out to sea. These are all of brick and backed with rubble masonry. Between the sewers and the reservoir is what is known as the six foot gallery which serves as a foundation for the gate house above, and as a protection for the gates from frost. It is divided by the division walls of the reservoir and four partition walls, one opposite the centre of each basin, into eight compartments. In both the outfall and discharge sewers, on the side next the reservoirs, are twenty gate openings, each three by four feet. Only half of these, eight in the outfall and twelve in the discharge sewers, are at present in use. The rest are bricked up until the increased amount of sewage renders them necessary. The gates with their frames are of cast iron, with bearing surfaces of composition. Both gates and frames are single castings, which are grooved to receive the strips of composition for valve faces and gate rests. The grooves are worked out by machine tools and the strips are riveted in place with composition rivets. The gates are pressed tight by adjustable gibs, bearing on inclined planes, cast on the frames. The gates are raised by lifting rods and screws, connected with suitable gearing above the floor of the gate house. The clutches for each gate are thrown in by a hand lever, and may be thrown out by hand or by the gate itself on reaching either end of its course. The gearing is driven by a main line of shafting, running the full length of the gate-house—575 feet—and varying in diameter from three and one-half to two and one-half inches. The power to operate the gates and for other purposes is furnished by a turbine wheel installed at the lower end of the outfall sewer, and driven by the sewage. The wheel pit drains into the discharge sewers. Ample power is furnished by the turbine for operating the gates, pumping and running other machinery about the works, at no expense for maintenance, and with no attention beyond opening and closing the gates leading to the wheel pit.

The reservoir has a capacity of about 25,000,000 gallons. Under ordinary conditions it will fill in about ten hours. In time of storm, however, the reservoir is not large enough to store the extraordinary quantities of sewage received, and it is frequently necessary to begin discharging before the turn of the tide. The frequency of this early discharge is constantly increasing with increasing population and water consumption, and might in time give cause for complaint to property owners on the water front of the city. The builders of the present reservoir foresaw the necessity of increasing its capacity in the future, and they so located and carried on the work that such an extension could be easily carried out by increasing the length of the basins. Such works are now in progress. The length and capacity of the basins will be doubled.

The method of discharging, flushing and filling the reservoir is as follows: An hour or so after high water, the water in the harbor being then about the height of the bottom of the reservoir, the gate leading to the wheel pit is opened and water is admitted to turbine. The shafting in the gate house starts and it is possible to raise or lower any gate by throwing its operating machinery into gear. First, the gates leading from the outfall sewer are closed, then those leading to the discharge sewers are opened. Under ordinary conditions the reservoir is empty in less than an hour. A deposit of slime remains in the bottom of the reservoir, generally quite thin, but in considerable quantities after a storm. To remove this the reservoir is flushed by the sewage stored in the outfall sewer. The openings from the reservoir to the six-foot gallery, excepting those next the side and division walls, are provided with gates hinged at the top and swinging into the six-foot gallery. Thus, while the basins discharge at all the openings they fill only from the two extreme openings. As soon as a basin is empty the lower gates at one side are closed and the upper gate on the same side opened wide. The sewage rushes in, filling one compartment of the six-foot gallery, and rushing into the basin by the one opening not provided with a gate, it flows up the gutter opposite that opening, and at the same time it spreads out over the ridges washing the slime into the gutters. As soon as enough sewage has entered, the upper gate is closed and the lower ones opened. The flush is drawn into the discharge sewers, where it is held till the next discharge, in order that, being the foulest of the discharge it may have an early start and be carried well out to sea. The flushing is done alternately from opposite sides of the basin. This method works well excepting that it will not clean the back corners of the basins of heavy materials, and a deposit of gravel, sand and sludge collects there which has to be occasionally shovelled out. Once a month or so the reservoir walls are washed by a fire stream furnished by a power pump driven by the turbine. Salt water from the harbor is used in this washing.

As it is not expected that the present method of flushing will be effective when the basins are doubled in length, a method has been devised by means of which the flushing will be done from the upper end. A large sewer will be built from the outfall around the upper end of the reservoir. On this sewer will be four gate houses, one opposite the centre of each basin, through which sewage can be admitted in sufficient quantities to thoroughly flush the basin. A system of stop planks will be provided to distribute the sewage over the width of the basin. The gates in these gate houses will be operated by compressed air pistons with valves operated by electricity. The compresser and perhaps a dynamo as well, will be operated by the turbine.

In winter scarcely any odor is noticed from the basins, but in hot weather an offensive smell arises at times. However, as no one lives nearer than the main land, a mile away, this is not a serious matter. Generally the tidal currents carry the sewage away from all inhabited places, but occasional complaints are heard from summer resorts along the coast. These are neither very earnestly made nor very seriously taken, and are probably due to a readiness to attribute the consequences of local carelessness to a distant cause. At the worst, however, the works quite fulfil their object in minimizing the nuisance caused by the sewage of the district they serve.

METALLURGICAL MACHINERY.*

BY A. C. M'CALLUM, M.E., PETERBORO, ONT.

In the matter of the design of metallurgical machinery it must be admitted, with reference to rolls, crushers, stamps and other machines employed in the reduction of ores, one is almost led to believe that they are not susceptible of as exact an analysis as a bridge for example. In the following remarks it is purported to deal with the most familiar machines employed by mining engineers, such for instance as crushers, rolls, stamps and feeders. To deal with them from the designer's point is my purpose.

Considering in the first place crushers, the introductory remarks anent them are applicable to most all of the other machines mentioned. It will readily be admitted that many de-

*From a paper read before the Canadian Mining Institute.

signs of crushers show by the distribution of the material within them, that the designer neglected to take advantage of a method of analysis commonly employed by designers of bridges and other large structures, a system of analyzing quite applicable to mining machinery, namely by that of graphics. The construction of a graphic diagram of stresses within any machine under design is most essential; as upon it the designer elaborates his working drawing. The benefits to be derived from such a process of designing cannot be overestimated, it impresses upon the designer an intimate and exact knowledge of the acting forces and their distribution throughout the parts of the machine in the process of design; there may be many problems which are extremely complex and frequently unsolvable; it is necessary however, to possess definite knowledge of the resistance of the materials employed in the construction of the machine to those complex forces.

It has been sometimes remarked that skill and good workmanship are not essential features in the make-up of mining machinery, but the idea is false, more plants built for the purpose of ore reduction have been failures, due in large measure to the fact that the enterprise was handicapped by machinery ill adapted for the purpose. It is to be much regretted that many engineers in the purchase of mining machinery estimate the superiority of the machines to be purchased by the dead weight, regardless of how the material is utilized and distributed. Discussion will not alone settle the question finally in all cases without elaborate and unprejudiced experimental work. Most careful investigation is necessary in many instances to discriminate between real improvement and the impractical. The sine qua non of good machine design, from a structural point of view, is the presence of sufficient material of the proper kind, in the right place. There are many types of crushers upon the market, and there is no doubt that the majority of them were originally intended for breaking road ballast. The demand within recent years for crushing machinery in mining regions is primarily the cause of their being advanced to the front as crushing and pulverizing machines. There is no doubt that the "Blake" type of crusher stands pre-eminently for service and has been generally adjudged the most efficient and economical in use; perhaps the reasons most readily advanced for such, lies in the fact that for a given capacity the first cost is less, the cost for repairs is also less, and they are idle for repairs much less of the time. The "Blake" type of crusher has developed few changes from the original design. The first type of "Blake" crushers had the crushing jaw pivoted at the bottom, as at present in general use the jaw is pivoted at the upper end. It is a matter of choice, to do a given amount of work by either of the types of machine; one with the working jaw pivoted above, the other below. For the jaw pivoted at the bottom, the plea is used that a more uniform product is obtained, and that finer crushing, when that is desirable, can be secured. The concurrence of preference however if gauged by use, is in favor of the modern "Blake" design with overhung jaws, when that type of crusher is chosen.

A general summary of crushers upon the market if analyzed would reveal the important fact of a want of harmony amongst the various types of similar dimensions. The dimensions of the openings are not called in question, but like pieces within different makes of crushers. So far as the openings of the jaws are concerned, those dimensions are not by any means arbitrary, but have been fixed by experience. Quartz generally breaking in sizes which can be suitably crushed by ore breakers of such standard dimensions as 10x7 in., 15x9 in., 20x10 in. Mining engineers in charge of plants are well acquainted with the many faults developed in crushers under their care, broken frames, pitmans, jaws and other parts are known. What then are requirements of a good crusher?

In order that the crusher shall run easily, cool, and prove serviceable, it is requisite that all of the journals be in correct alignment one with the other. Rigidity, strength and sufficient weight must be found in the frame, so that the vibrations created while crushing may become absorbed. This must be advanced as the reason for the failure of the many types of steel plate frames, they easily yield to the strains within the machine, thus causing the working parts to become out of proper relation one with the other, and resulting in heating, and running hard. According to the nature of the product to be crushed, we must have a certain direction of stroke, length of stroke, and relative angle in the position of jaws, and to procure those conditions various means are employed, which methods are well known to mining men. But it has appeared to the writer that simplicity of construction may be secured by abolishing from the type of crusher under consideration, the wedge block so common, and employing other means of adjustment, for instance by means of the toggles. Change of toggles can be effected as readily as by means of the adjustable wedge. The movement required can then be made by rearrangement of the toggles. The machine being provided with a set of toggles giving the requisite maximum and minimum openings. It is necessary that the shaft supporting the jaw should be securely fastened to the jaw, not by means of set screws, a preferable method of fastening is that of the gib and key. The jaw shaft is then required to move in the bearings of the machine. This overcomes the pounding and jumping due to lost motion, which readily develops when the jaw moves upon the shaft. The caps of the bearings can then be tightened whenever wear renders it necessary. Within the pitman much trouble is often created, perhaps no other feature within the make-up of the pitman creates more trouble than the adjustable devices provided to take up wear, when the eccentric shaft has worn out of round, due to the strain upon it being constantly in one direction.

Fly-wheels as commonly fastened to crushers are at fault. By employing them as a means to prevent serious injury to the working parts of the machine, owing to sledge hammer heads falling into the jaws, or other causes, we may so fasten the fly-wheel upon the shaft that in case of accident the belt may slip and the crusher stop while the fly-wheels exhaust their motion. We may use taper keys.

The reduction of granulation of coarse particles of ore by means of rolls, has been given much consideration during the past few years. The variety of crushing rolls are many and various in type and construction. Machines for this class of work have been largely involved by American engineers, and proof of their superiority is to be found in the fact of their having gained admission to almost every large metallurgical work throughout the world. Notwithstanding the many changes that have been made during past years in all the various designs known to us, no special one has met with general approval. The most potent change has been in the adoption of steel as the material for use in the construction of the shells. The construction of the frame in one piece, having sufficient weight and strength to absorb the vibrations set up within the machine, and closer study has been given to the matter of the strains with the structure. Marked improvement over the older forms of crushing rolls has been made in the design of journal bearings, methods of lubrication, and the facilities for dismantling the machine if required. Considerable ingenuity has been displayed to obtain complete and satisfactory methods for keeping the lateral adjustment of the rolls correct. The adoption of springs for that of levers and dead weights within the machine to give crushing power to the rolls is an important improvement, affording as it does, a much more uniform product. The adoption of some form of housing obviates the wasteful and disagreeable nuisance of dust usually found around rolls employed in dry crushing, and length of life to the machine is ensured. The most marked change within recent years has been along the line of increased peripheral speed, by the employment of rolls of larger diameters, and narrower faces. The results being decrease of journal friction, increase of crushing surface, and reduction of spring pressures. Those changes are undoubtedly the direction in which modern practice is tending. Peripheral speeds of 600 to 1,000 feet per minute are now found to be practicable, but this change in speed has also brought about many of the improvements already mentioned. The aggregate spring pressure is now greater, ranging from 2 to 3 tons per inch width of face of roll shells. Change has also been made from gears to belts, proving a much more preferable method of driving. In the earlier form of rolls, the spring pressure was carried along the main tension bolts, making it a matter of considerable labor to adjust the rolls. The method now in use consists of enclosing the whole nest of springs between two washers, and constructing them so that each nest forms a complete washer of an inelastic nature, until such time when the maximum pressure is reached, further compression taking place, relief is afforded to the rolls by the deflection of the springs. Chilled iron shells in all probability

will be displaced by steel shells. In the design of rolls presented all the above mentioned improvements have been embodied, simplicity of construction, fewness of parts, and interchangeability is to be found. The hopper underneath the rolls is constructed in such a manner that no pockets are permitted, all four sides declining towards the bottom at an angle of 45 degrees, thus affording cleanliness at all times within the machine. The matter of sliding versus swing bearings for the removable roll, was decided in favor of swinging roll bearings. The wearing surfaces become reduced by means of their adoption. Any wear about the bearing surfaces of sliding roll bearings is an evil which may result in damage to the frame of the machine; it is easier to maintain the alignment of the swinging bearing in the sliding type of bearing. In design for rolls, a feature worthy of consideration is that of the disposition of the bolts employed for the purpose of bolting the machine together, it is a desirable feature to have as few as possible, and so arranged that should they by any means become loose, they may not fall within the machine. The use of common nuts is not desirable, and recourse must be made to lock nuts or elastic nuts; this provision prevents the bolts becoming loose, and may help to preserve the machine from injury.

The construction of mortars will always prove interesting to mining men. The sectional mortar contains a feature new to the writer. It is usual in the construction of sectional mortars to make the ends in two pieces. In this particular mortar, to overcome making the ends in the above way, they were carefully designed (not to exceed 350 lbs. in weight) and in making the ends of cast steel the joint usually found was eliminated, and considerable strength has been thus added. The drawing shows the construction clearly. This type of mortar was designed for the Ben d'Or Mine, Bridge River, B.C. In the 3-stamp double discharge mortar, the lower guides of the battery are to be found in the upper part of the mortar, water supply is carried to and around to each of the heads. The pulp from back screen running through a channel cored in base of mortar and joining to that of the channel from front screen is then carried by a pipe and distributed over the amalgam table. This type of mortar was designed for the Oro Fino Mill of Fairview district, B. C. Amongst designers of mining machinery the ore feeder has been taken in hand, and it doubtless has been observed in recent designs presented for public favor that of the suspended type shows many marks of improvement in design, utility and simplicity of construction. The marked changes in this feeder are to be seen in the abolition of the adjustable mechanism to the feed lever, the lever adjustment being made by means of a collar on the stamp stem, or by the bumping rod. Gears are not employed at all, thus resulting in quiet running. One could, perhaps, make extended remarks with regard to other machines in process of design and manufacture. I feel I have not done justice to the subject, it is much too wide for a single paper. Papers on metallurgical machines to be of real benefit to the Institute should be divided into sections, treating of the design and dynamics of each machine in separate papers. Should it be the pleasure of the Institute I would willingly contribute my small quota. Publication of data thus collected may not be considered of much moment by the busy outer world, but it clarifies the writer's ideas, and brings into compact form and small bulk, a large amount of knowledge otherwise unattainable. This information adds much to the making of the routine work of the profession more productive and pleasurable.

THE NOVA SCOTIA COAL TRADE.

The following returns of Nova Scotia coal sold during the year 1898, shown in the report of the Department of Mines, Nova Scotia, in comparison with those of 1897, are as follows:

	1897.	1898.
Nova Scotia	641,308	667,252
New Brunswick	242,043	266,789
P. E. Island	62,032	93,241
Newfoundland	75,990	62,051
Quebec	875,874	944,160
West Indies	9,356	.....
United States	106,279	98,027
Other countries	.....	3,877

The production was 2,281,454 tons compared with 2,320,916 tons in the year 1897. There is an increase in the sales in Nova Scotia, New Brunswick, Prince Edward Island and Quebec, the sales to the last named point coming close to the million mark. There has been a decrease in the Newfoundland and United States sales. It is confidently expected that in a few weeks shipments of gas coal to Boston from Cape Breton collieries will be commenced on a basis of at least 700,000 tons per annum. If this be carried out and no unforeseen obstacle intervenes, the total sales of next year should be in the vicinity of 3,000,000 tons. The total sales for the year were 2,135,397 tons, compared with 2,013,421 tons in 1897.

THE PRACTICAL MAN.

The Friction of Metal on Metal, without Lubrication—
May be taken at 1-6 of the weight up to 40 lbs. per sq. inch.
May be taken at 1-5 of the weight up to 100 lbs. per sq. inch
Brass on cast iron ¼ of the weight up to 800 lbs. per sq. inch.
Wrt on cast iron 1-3 of the weight up to 500 lbs. per sq. inch.
Well oiled with tallow at 1-10 of the weight.
Well oiled with olive oil at 1-3 of the weight; 800 lbs. per inch forces out the oil; friction of journals under ordinary circumstances 1-30 of weight; friction of journals well oiled sometimes only 1-60 of weight.

Rules for Calculating Speed.—The diameter of driven given to find its number of revolutions: Multiply the diameter of the driver by its number of revolutions and divide the product by the diameter of the driven. The quotient will be the number of revolutions of the driven.

The diameter and revolutions of the driver being given to find the diameter of the driven, that shall make any number of revolutions: Multiply the diameter of the driver by its number of revolutions and divide the product by the number of required revolutions of the driven. The quotient will be its diameter.

To ascertain the size of pulleys for given speeds: Multiply all the diameters of the drivers together and all the diameters of driven together; divide the drivers by the driven. Multiply the answer by the known revolutions of main shaft.

To Drill or Turn Aluminum.—Use kerosene oil (coal oil) for drilling or turning aluminum.

To Drill Hard Steel.—Use turpentine instead of oil, when drilling hard steel, saw plate, etc. It will drill readily when you could not touch it with oil.

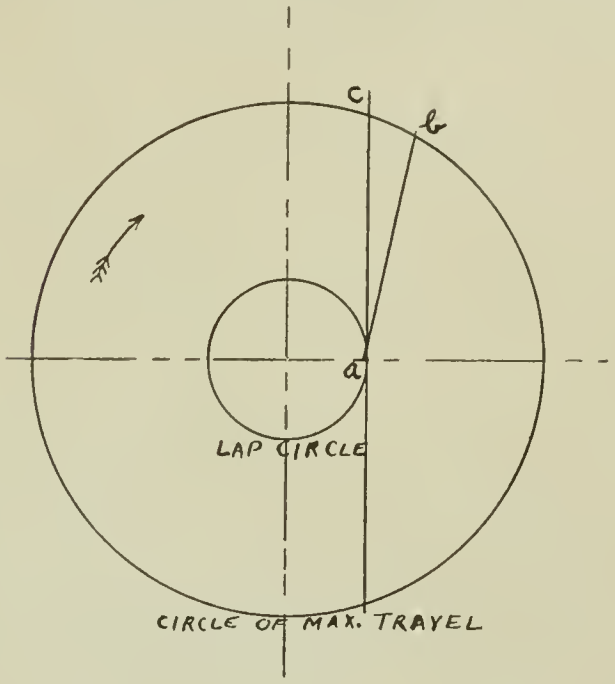
To Prevent Rust on Tools.—Use vaseline, to which a small amount of powdered gum camphor has been added; heat together over a slow fire.

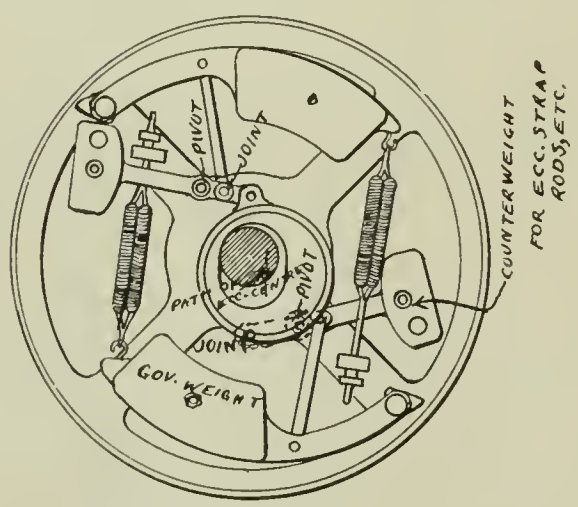
Alloys.	Tin.	Copper.	Zinc.	Antimony.	Lead.	Bismuth.
Bráss, engine bearing	13	112	¼	..	..	..
Tough brass, engine work	15	100	15	..	..	..
Tough, for heavy bearings	25	160	5	..	..	..
Yellow brass, for turning	..	2	1	..	..	..
Flanges to stand brazing	..	32	1	..	1	..
Bell metal	5	16	..	..	..	..
Babbitt's metal	10	1	..	1	..	..
Brass, locomotive bearings	7	64	1	..	..	..
Brass for straps and glands	16	130	1	.	..	..
Muntz's sheathing	..	6	4	..	..	..
Metal to expand in cooling	..	..	..	2	0	1
Pewter	100	..	..	17	..	..
Spelter	..	1	1	..	..	..
Statuary bronze	2	90	5	..	2	..
Type metal, from	..	..	..	1	3	..
Type metal, to	..	..	..	1	7	..
Solders.						
For lead	1	..	..	..	1½	..
For tin	1	..	..	..	2	..
For pewter	2	..	..	..	1	..
For brazing (hardest)	..	3	1	..	..	..
For brazing (hard)	..	1	1	..	..	..
For brazing (soft)	1	4	3	..	..	..
For brazing (soft), or	2	..	..	1	..	..

NOTES ON SHAFT GOVERNORS.*

BY W. B. M'LEAN.

The following paper does not propose to discuss the many difficult mathematical and other problems involved in a treatment of the theory of shaft governors. It will only deal with some practical points in the design of these appliances which have come to the notice of the writer during a summer spent at work connected with high-speed engines which were thus





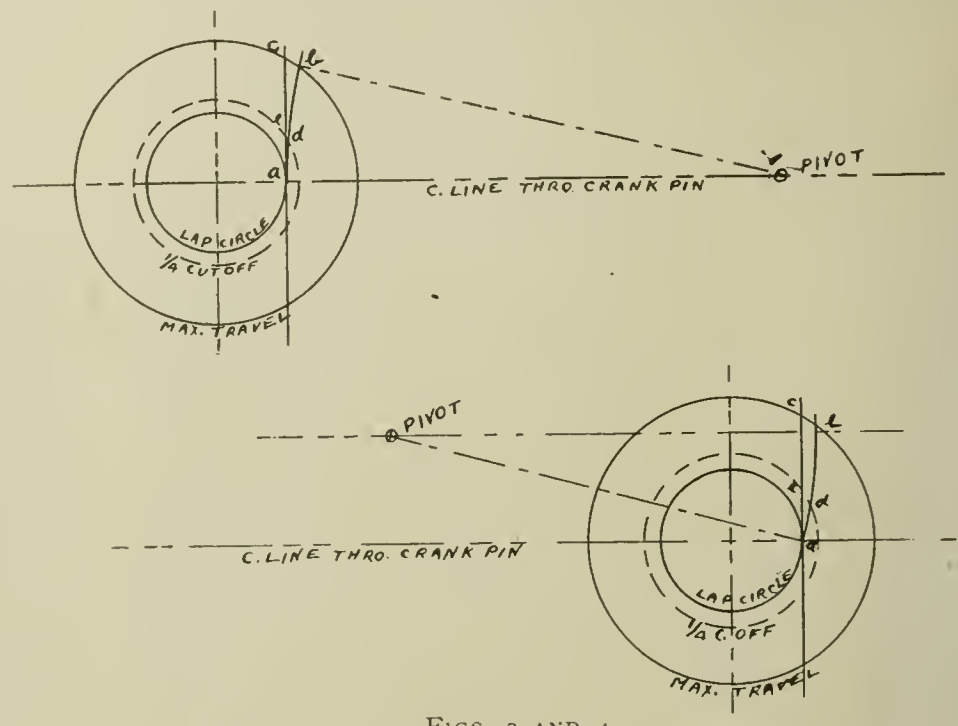
FIGS. 1 AND 2.—AUTOMATIC GOVERNOR. FITCHBURG CO. STEAM ENGINE.

governed. The shaft governor is the means now almost universally employed for regulating the speed of the modern (American) high-speed engine. In most American engines it acts by changing the point of cut-off of the valve, and thus varying the volume of steam admitted to the cylinder at each stroke to suit the varying loads. This of course changes the ratio of expansion; but between the ordinary limits of cut-off, under working conditions, the variations of this ratio do not greatly affect the economy, and the regulation is much quicker than with the old type of throttling governor.

In the older forms of shaft governor the cut-off was changed by having an eccentric of the ordinary type placed loose upon the shaft, which was turned around by the governor so that the angle of advance varied, about from 0° to 90° under the full movement of the governor. (Fig. 9.) In more modern forms, however, the object is to have the eccentric centre describe a path, relatively to the shaft, such as that shown in Fig. 1. Here the large circle has a radius representing, on some scale, the half-travel of the valve or the throw of the eccentric, at the point of greatest cut-off, and the small circle has a radius representing, on the same scale, the outside lap; *b* is the position of the eccentric centre which gives the proper lead when the valve has its greatest travel. The path which the eccentric centre is required to describe under the action of the governor is from *b* to *a* where *a* is a point either at or slightly inside of the intersection of the lap circle with the centre line through the centre of crank pin and centre of shaft. At the minimum travel of the valve there will then be no admission of steam at all to the cylinder and the lead will diminish from *bc* to *o*, or to a small negative lead at *a*. as the eccentric is moved in by the governor. The form taken by the line *ba* is

*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in the Canadian Engineer.

a matter on which designers differ. In the governor shown in Fig. 2 it is made very approximately a straight line by an application of Watt's parallel motion. The form usually adopted, however, is that of a circular arc, the eccentric plate being pivoted directly on the supporting governor frame or wheel. By this arrangement a greatly increased rigidity is obtained to resist the pull necessary for moving the valves; which pull generally comes at a considerable off-set. There are two ways in which this pivot may be placed as shown



FIGS. 3 AND 4.

in Figs. 3 and 4. To compass the two the circle is drawn which represents the path of the eccentric centre at ¼ cut-off. The lead at ¼ cut-off is in each case *de*; and it will be seen that the arrangement of Fig. 4 gives much more lead and also a greater maximum port opening at the early cut-offs than does that of Fig. 3.

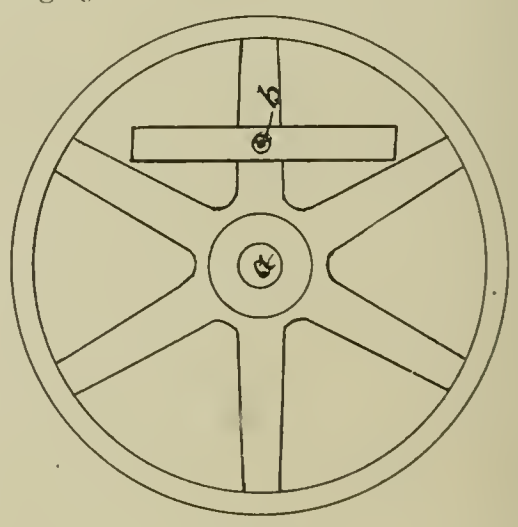


FIG. 5

The desired movement of the eccentric plate is ordinarily obtained by connecting it to weights, pivoted in the governor frame so as to be movable in the plane of rotation, the movement of the weights being controlled by springs. When the rate of rotation of the shaft changes new forces act on the weights which produce the desired movement. The most im-

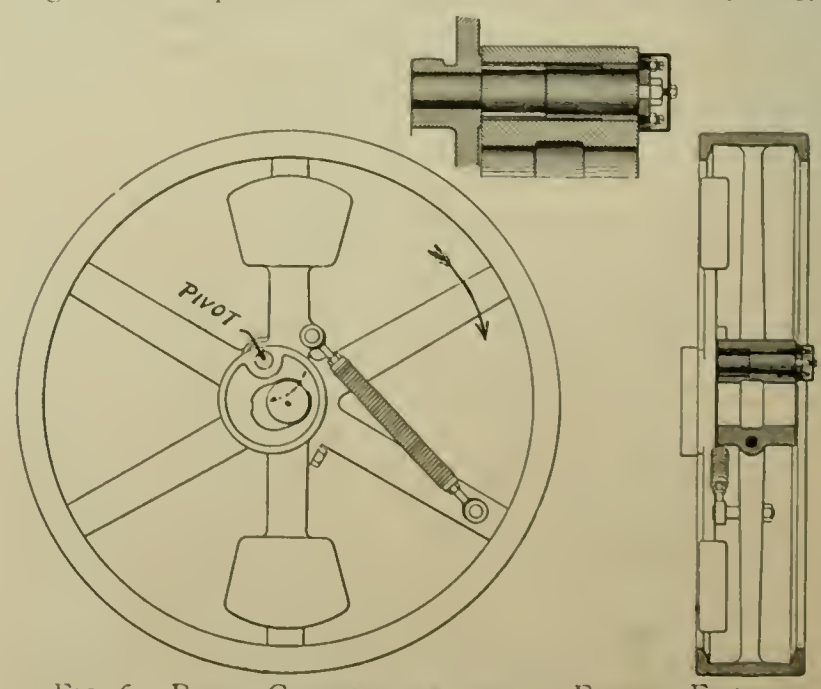


FIG. 6.—RITES GOVERNOR AS USED BY FISCHER FOUNDRY AND MACHINE CO., PITTSBURG.

portant of these is the change of the centrifugal force. This is, however, by no means the only force made use of. Forces due to the inertia of the masses themselves are now largely used. Suppose we have a weight, as shown in Fig. 5, in the form of a long bar pivoted at *b* to a frame rotating about *a*. Then in addition to its rotation as a whole about *a*, the weight will have a rotation at the same rate about *b*. If the rate of rotation about *a* change, that about *b* will still tend to remain the same, and the weight will consequently turn on the pivot *b*. The couple producing this movement depends for its magnitude upon the moment of inertia of the weight about the axis through *b*. This couple may be called angular accelerating couple. The Rites' governor, which has been recently brought out and is now used by a large number of prominent American

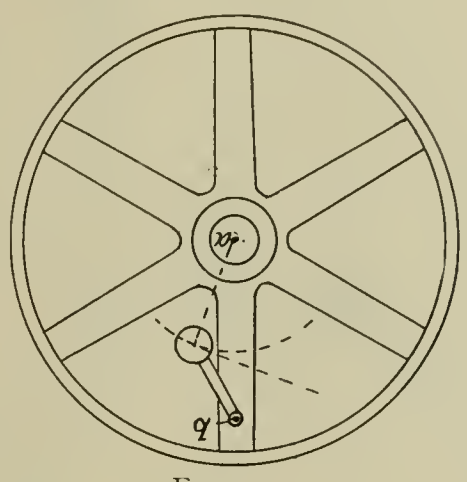


Fig. 7.

engine builders, depends for its action principally upon this force. As seen in Fig. 6 the weight arm and eccentric plate are made in one piece, thus necessitating the arrangement of the pivot shown in Fig. 3. This governor gives very quick regulation, but from the very nature of its action a light fly-wheel must always be used with it. Its action depends not on the total change of rotation but on the rate of change or angular acceleration.

Let a weight in the form of a ball at the end of a lever arm be placed in some such position as that shown in Fig. 7, so that the tangent to its path at the centre of gravity falls some distance to one side of the pivot. Then, if the rotation about *a* be accelerated, it is evident that on account of its in-

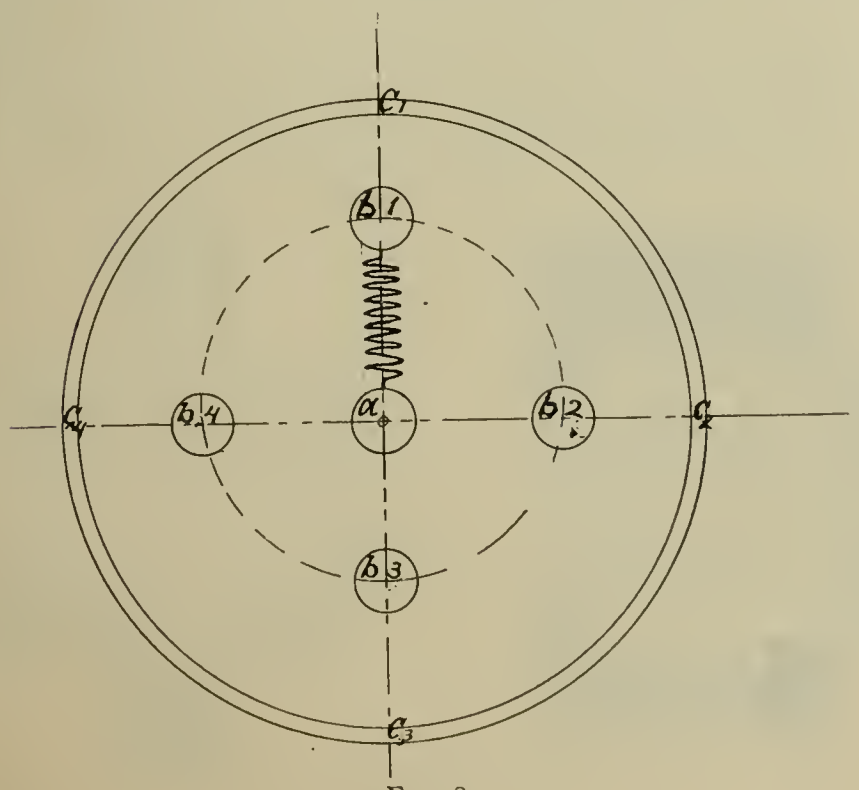


Fig. 8.

ertia the weight would resist the change of linear velocity due to a change of angular velocity (and of radius of rotation if a movement about *b* did occur), and a force would be produced tending to cause motion of the weight about *b*. But this is not the only force developed in this case, and Prof. J. G. Klein has demonstrated to the satisfaction of leading engineers, who have discussed this subject (see Trans. Am. Soc. M.E., 1897, discussion on paper by F. H. Ball, p. 311), that in such a case the resultant of all the forces developed always passes through the pivot. The force mentioned will therefore not be available for governing. The two prominent forces made use of in shaft governing will then be centrifugal force and angular accelerating couple, and it is in the combination or opposition of these that the action of different governors varies.

In the case of weights rotating about a horizontal axis as is the case in shaft governors the effect of gravity must be taken into account. To show what this would be in the case of a single unbalanced weight take the following case: Suppose a wheel (Fig. 8), moving at a constant rate of rotation to

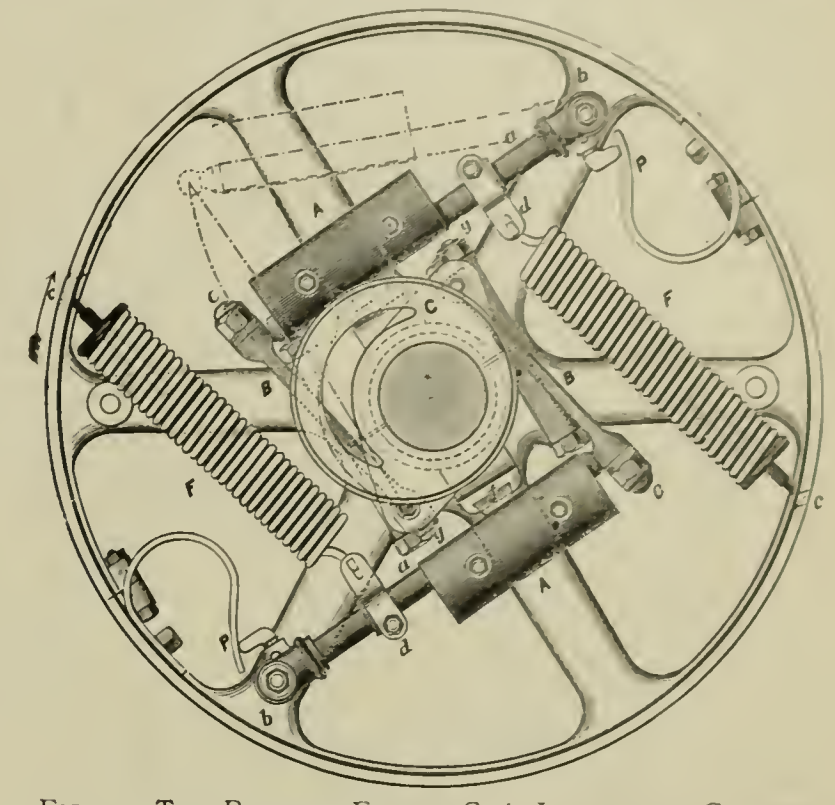


Fig. 9.—The Buckeye Engine Co.'s Isochronal Governor.

have a weight placed in it so as to be movable, without friction, only along the radius *ac*, of which ac_1, ac_2, etc., are successive positions as the wheel makes a revolution. Also suppose that a spring is attached to it and to the wheel which balances the centrifugal force in all positions, that is makes it isochronous. Then the only force which we need consider will be that of gravity. Starting from the position *b*, the weight will be pulled towards *a* until it reaches b_2. At b_2 it will cease to be pulled towards *a*, but will then have a certain velocity inwards. From b_2 to b_3 this velocity will be destroyed by the retarding force of gravity pulling it away from *a* again. At *b*, it will have reached its nearest position to the centre *a*, and will start mov-

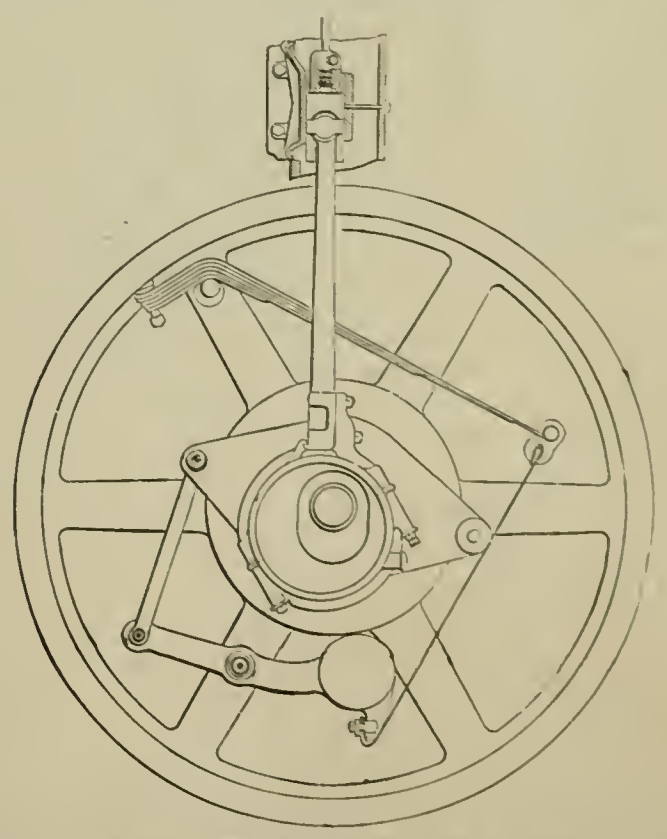


Fig. 10.—Governor and Valve Motion. Straight-Line Engine Co.

ing out again. At b_4 it will have its greatest velocity outwards, which from b_4 to b_1 will be destroyed again by gravity until it reaches its extreme outward position at b_1. By experiment and mathematical demonstration Prof. S. P. Robinson has shown (Trans. Am. Soc. M.E., 1890, pp. 1055-64, discussion on paper by J. E. Sweet), that the path of the weight under these cir-

cumstances is very nearly a circle, whose centre is vertically above the centre of rotation by a distance $\frac{g}{w^2}$ where g = acceleration due to gravity and w = angular velocity in radius. It will be seen from the above that if a governor weight be unbalanced, one effect of gravity will be to make it move more or less on its pivot at every revolution, and thus move the whole governor. The argument for balancing is that this makes the pins wear out and necessitates increased lubrication. Two methods of balancing may be noticed. The first is that of

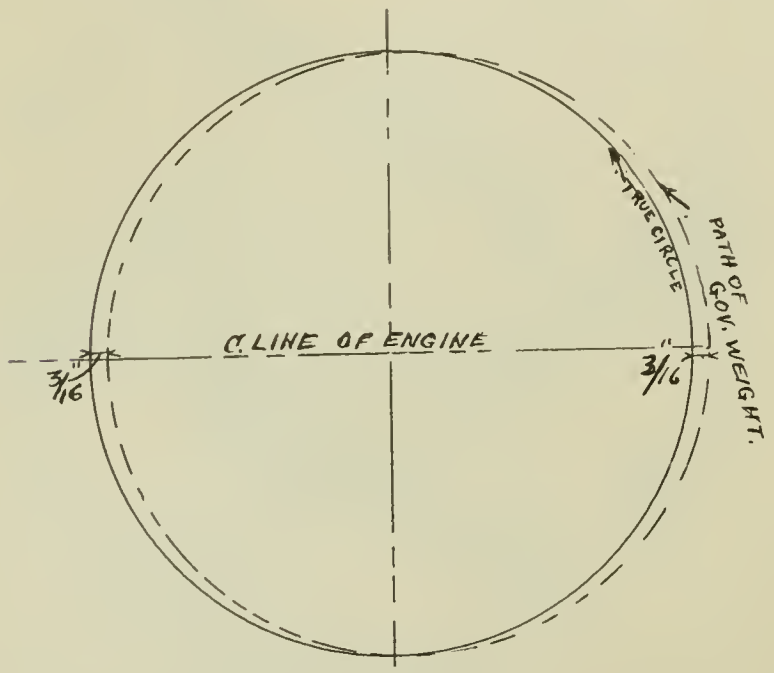
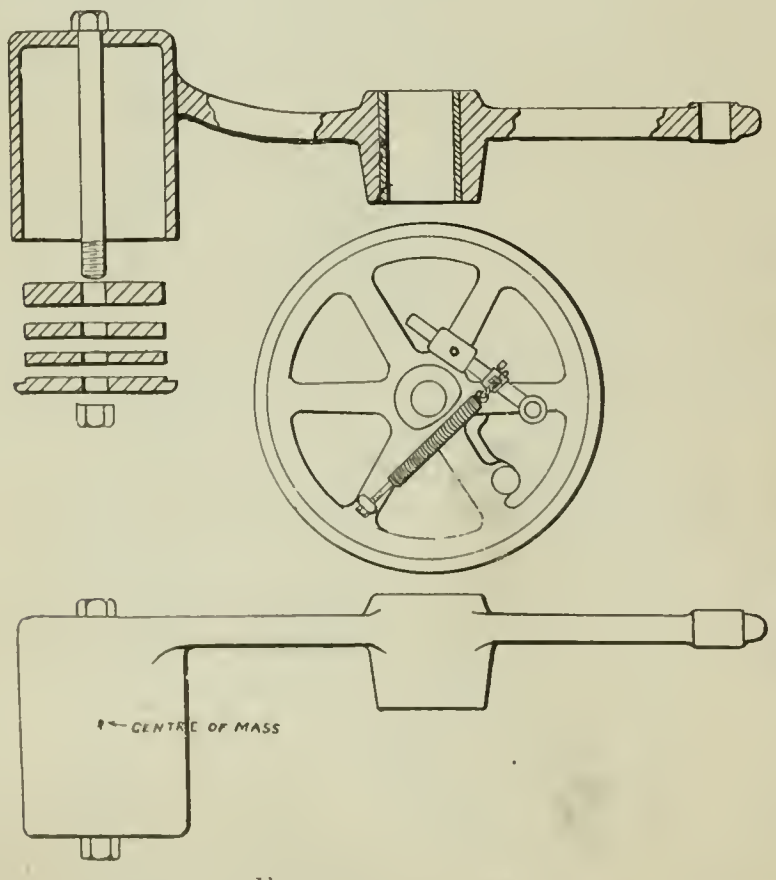


FIG. 11.

duplicating the weights and connecting them to opposite sides of the eccentric plate pivot as in the governor shown in Fig. 9. The second, shown in Fig. 10, is to make the weight of the eccentric plate and connections balance that of the weight. The governor shown in Fig. 2 presents a peculiarity in balancing in the counterweights *o o*, which are put in to balance the weight of the eccentric plate and strap, and in vertical engines of the valve and rods also, and thus relieve the governor of these disturbing influences.



FIGS. 12, 13, AND 14.

The resistance of the valve is another element of disturbance in the shaft governor. It is principally due to three causes, friction, inertia, and unbalanced steam pressure. The friction in the best practice is reduced to a minimum by the use of balanced valves, and by accurate scraping processes, thorough lubrication, etc. The inertia is reduced by making the valve and connections as light as possible. The unbalanced steam pressure is not generally accounted for as it is not generally recognized as a disturbing force. It is due to the unbalanced area of the valve rod which enters one side of the steam chest and does not usually pierce the other. Thus the pressure on the one side of the valve will not be perfectly balanced by that on the other, and there will be a constant force tending to push the valve towards the shaft, which will be equal to the area of the valve rod steam pressure per square inch. In conjunction with the others mentioned this force may cause considerable trouble in a governor, as may be illustrated from the case of a 12-inch tandem compound engine, which was found to have too light a governor. A pencil was attached to the governor weight and a board was held up against it while the engine was running, and thus the actual path of the weight was traced on the board. The true circle concentric with the

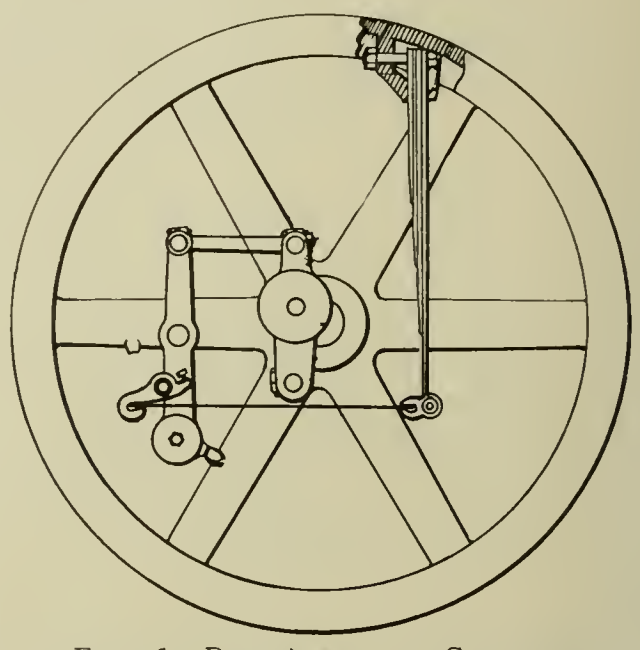


FIG. 16.—ROBB-ARMSTRONG GOVERNOR,

shaft, which the pencil would describe if the weight had been fixed in the wheel, was also described on the same diagram. It was thus found that the path of the governor weight was, as shown in Fig. 11, sensibly a circle whose centre was displaced horizontally from the centre of the shaft by about 3-16 of an inch. This of course disturbed the adjustment of the valves, both of which were attached to the governor in this case, and made it necessary to put on a much larger and more powerful governor. Some makers point out the influence of the valves as rather an advantage, and seemingly for the same reason that the somewhat similar effect of gravity is claimed by others to be a disadvantage. It is argued that the alternate push and pull due to the inertia and friction of the valve gear tends to, and doubtless does produce a small movement of the governor and that this overcomes the friction of rest at the joints four times in each revolution, thus making the governor more sensitive and free to act. Governor weights, especially when in the form of

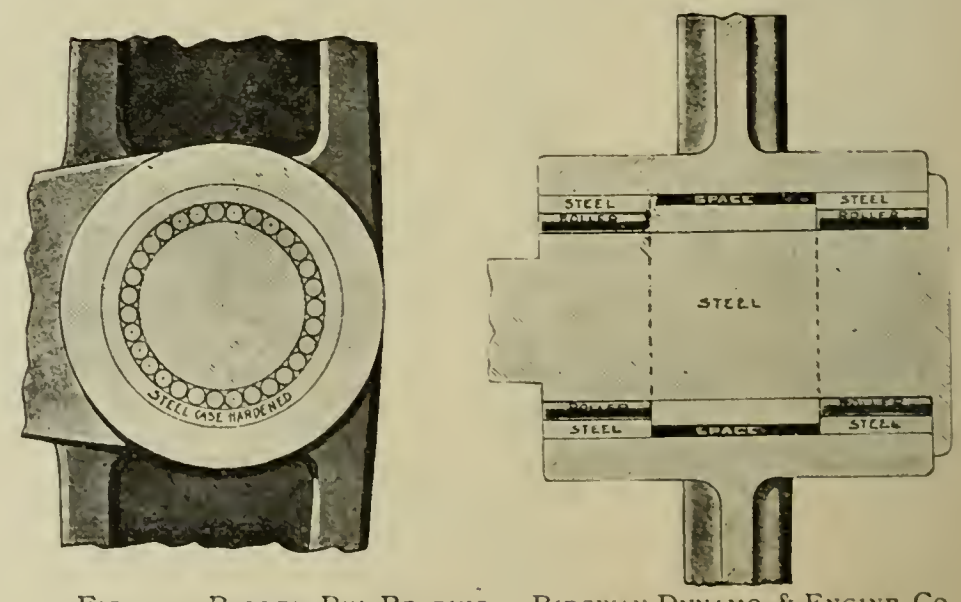


FIG. 17.—ROLLER PIN BEARING. RIDGWAY DYNAMO & ENGINE CO.

a ball and lever, are often made adjustable both as to mass and leverage. An adjustment for mass is shown in Fig. 12, where the governor ball is cast hollow, of malleable iron and weights of varying thickness put in until proper working is secured. Adjustments for leverage are made by making the weight so that it can be moved along the lever arm and clamped in any desired position as shown in Fig. 13. A consideration of some importance which is often lost sight of in designing governor weights is to so distribute the mass of the weight as to avoid as much as possible twisting couples on the weight pivot at right angles to plane of rotation, as these cause rapid and uneven wear. To illustrate what is meant Fig. 14 shows a possible

distribution of the mass of the weight shown in Fig. 12, which would cause it to have the bending or twisting couple about its pivot, referred to.

The springs used to control the movement of the weights are of two kinds, coil springs and flat-leaved springs. Coil springs are almost always used in tension. In using them stresses are developed due to the centrifugal force of their own mass, which at high speeds become of some importance and cause the spring to assume a slightly curved form. Means must be provided for adjusting their tension. Examples of these may be noticed in Figs. 6 and 13. The ends of these springs are generally fastened with simple pins as shown in Fig. 6, but sometimes have knife-edge bearings to do away with friction. There are two ways in which flat-leaved springs may be used, either to push the weights in as shown in Fig. 15, the weight being on the same side of the centre as the spring, or to pull it in by a connecting strap, the weight and spring being on opposite sides of the centre as shown in Figs. 10 and 16. In the arrangement of Fig. 15 the centrifugal force due to the mass of the spring itself will oppose its action, and if the spring be made stronger to resist this opposing force its mass must be increased, and thus the opposing force will also increase and hence a much stronger spring is necessary with this arrangement than with that of Figs. 10 and 16, where the centrifugal force of the spring itself assists its action. Arrangements for adjusting the tension of flat-leaved springs are applied, either at the fixed end of the spring, as shown in Figs. 10 and 16, or at the moving end, as shown in Fig. 15. When the spring is connected to the weight by a metal strap an important and useful adjustment of the spring's action may be made by the use of a quadrant, as shown in Fig. 16. As the weight goes out the leverage of the spring in acting on the weight may be made to vary in any desirable way by adjusting the quadrant to different angles about its pivot, and by making the face in profile of different curves. The curve usually adopted, however, is that of the arc of a circle.

The joints and pivots are among the most important items to be considered in the construction of a governor. If there be too much friction the governor is apt to stick at first when the load changes, and then to move suddenly and too far, thus causing racing of the engine. The ordinary construction is to bore out the bearing, say ⅜-inch larger than the pin, and to press or clamp in a bush, which can be replaced when it wears out. These bushes are usually of hard babbitt metal or some similar alloy, or of brass, but graphite is often used. A more expensive construction, which is coming into favor, is that of a roller pin bearing, as shown in Fig. 17. Governors have been designed with the weights pivoted on knife-edges, but the idea does not appear to have been prosecuted with much success, although knife-edges are used on the springs by some makers as has been mentioned. The shaft governor has now been brought to such perfection that the variation of speed with the best types between no load and full load or between maximum and minimum boiler pressure, is a small fraction of 1 per cent. of the average speed. They are so simple in their action that they require almost no attention, and with proper design and workmanship are as durable as any part of the engine.

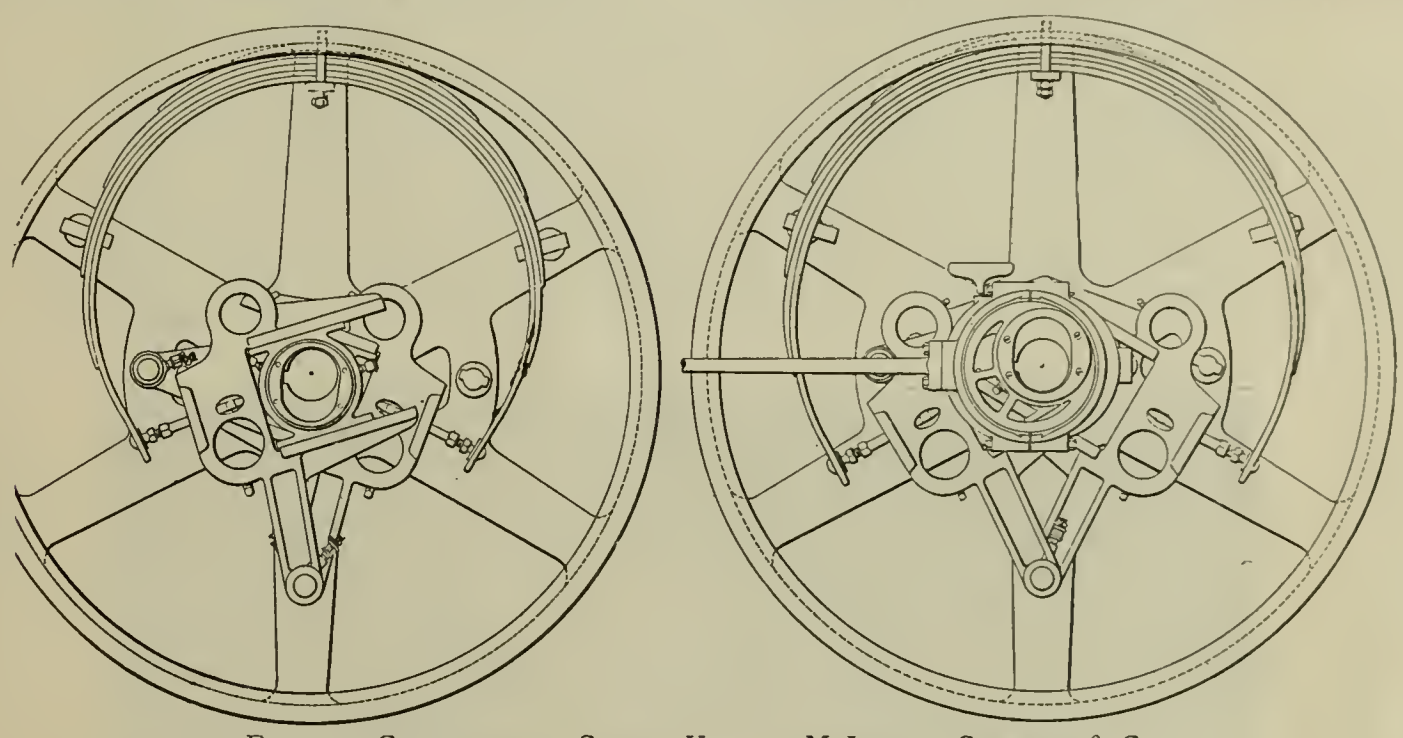


FIG. 15.—GOVERNOR FOR SINGLE VALVE. McINTOSH, SEYMOUR & Co.

THE ELECTRIC POWER AND LIGHTING PLANT OF THE SOULANGES CANAL.

The Canadian General Electric Co. is supplying the electric power and lighting plant for the Soulanges Canal upon specifications of which the following is an outline:

GENERATORS.—There will be two generators of multi-phase type of 110 amperes at 2,400 volts, (264 k.w.) when operated at a speed of 225 r.p.m., frequency 60 p.p.s. Each generator to be direct connected, and when the generators have been operated at the above capacity for twelve consecutive hours, the temperature of the hottest part of the machine shall not be more than 45 C. above that of the surrounding atmosphere. The machines are to be so constructed that the insulation between the armature winding and frame of the machines and also between phases, will withstand a break-down test of 6,500 volts for five consecutive minutes, such test being made with a transformer of not less than 4,000 watts capacity. The insulation between field winding and frame of machines shall withstand a break-down test for five consecutive minutes of an alternating voltage equal to five times the voltage to be used in exciting the generators. The armature and field winding insulation to be capable of withstanding the break-down tests specified, immediately after generators shall have been operated at the load runs above stipulated. The generators will have an inherent regulation of at least ten per cent. The generators are not to have so-called "compounding devices." Regulating appliances must be provided so that the E.M.F. of each or any phase may be varied ten per cent entirely independently and separately from each other. When the generators are operated under full load they shall have a commercial efficiency of at least ninety-two per cent.; when operated at half load, of eighty-nine per cent., and at quarter load of eighty-four per cent.

EXCITERS.—There are to be two exciters of modern design, with self-oiling bearings, and to be provided with a belt-tightening device. The armature to be of the iron-clad type, and the armature coils "machine wound." The capacity of the exciter to be such that it will deliver continually, without undue sparking, exciting current to an extent equal to two times that required by one generator when it is operating at its maximum load. The temperature of any part of either exciter, after working for twelve hours at about stated output capacity, shall not exceed 45° C. above the surrounding air.

SWITCHBOARD APPLIANCES.—The switchboard appliances will be mounted on marble slabs, supported on an oak or iron frame, and consist of the following instruments: 2 voltmeters, 2 main switches or set of switches, 2 voltmeter transformers, 2 exciter switches, 2 voltmeter switches, so arranged that the voltage can be determined of each phase, 1 ampere meter for each phase of each generator, 2 generator rheostats, 2 exciter rheostats, 2 motor circuit switches and ampere meters, 2 arc light circuit switches and ampere meters, 1 static ground detector, 1 switch for ground detector, so that connections can also be made to each phase, also the necessary bus bars, pilot lamps, etc. There shall also be supplied the necessary lightning arresters for the protection of the switchboard and generating

apparatus from lighting discharges from the outside line; each lightning arrester to be equally efficient as any at present made.

All wiring in connecting the generator and exciter to switchboard and to line to be done with rubber-covered wire and according to the rules and regulations of the Canadian Fire Underwriters' Association.

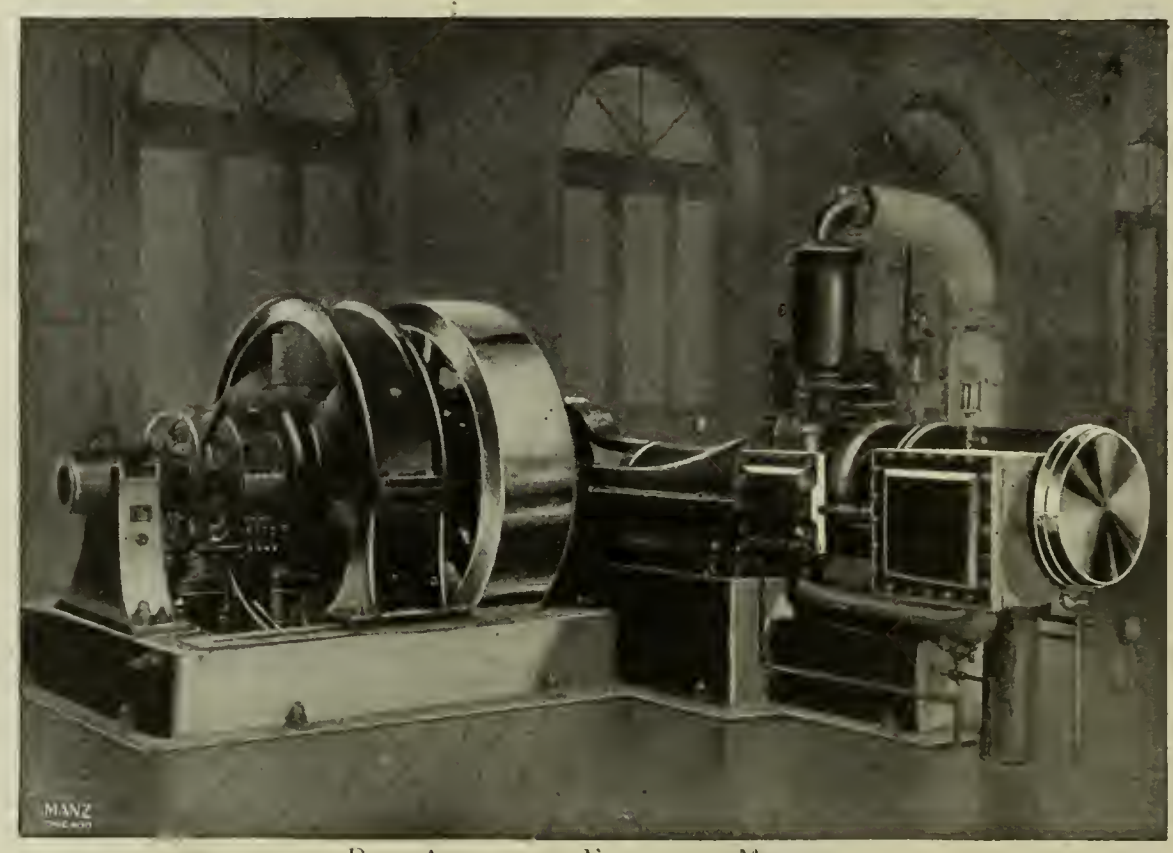
Motors.—The following motors to be furnished, erected and installed in motor housings, to be furnished by the contractor at each one of the five locks: Lock No. 1, at the lower entrance to the canal; lock No. 2, at about 1,900 feet from the lower entrance of the canal lock; No. 3, at about ¾ of a mile from the lower entrance of the canal; lock No. 4, at about 3 miles from the lower entrance of the canal; lock No. 5, at the upper entrance of the canal or about 14 miles from the lower entrance of the canal; guard gates at about 3½ miles from the lower entrance of canal. Twenty (20) 1 h.p. motors, one to be connected to each of the four sluice gates at each lock, each motor to be provided with the necessary mechanism, reducing gears, etc., to operate the shafts of the sluice gates; twenty-two (22) 7 h.p. motors, one to be connected to each of the gates at each lock, each motor to be provided with the necessary mechanism, reducing gears, etc., to drive the pinions operating gate bars; each of the above motors to be also supplied with the necessary releasing or brake arrangement, so that in opening or closing the gates, the power may be released automatically so as to prevent any undue strain on the machinery in connection with the gates. Seven (7) 2 h.p. motors, each to be placed and connected with suitable mechanism ready for the operation of each of the seven bridges, situated along the canal; each motor to be provided with its necessary switch, starting box, etc. One (1) 15 h.p. motor, complete, with the necessary starting box, switch sliding bars, etc., to be installed at a workshop to be erected near the lower end of the canal. At each of the five locks and at the guard gates there shall be installed in a building to be provided therefor, a switchboard to which will be provided the necessary switches and instruments for effectually and completely handling and controlling the operation of all the motors required at each lock. Where it becomes necessary for wires to cross the canal, such wires shall be lead covered, and shall be placed on the bed of canal or locks at places to be determined by the Government engineer, and shall be placed in such a manner that they cannot receive any injury.

Transformers.—The following transformers are to be supplied and erected, as follows: 5 transformers, each suitable for four 1 h.p. and four 7 h.p induction motors, one to be installed at each lock; 2 transformers, suitable for two 7 h.p. induction motors, to be installed at guard gates; 7 transformers, each suitable for one 2 h.p. induction motor, one to be installed at each bridge; 1 transformer, suitable for one 15 h.p. induction motor, and to be installed at the workshop at the lower end of the canal. Each transformer will withstand a break-down test of 6,000 volts of alternating current, for five consecutive minutes, between the primary and secondary coils, between primary and iron, and between secondary and iron. No part of the transformers are to have a rise in temperature when in use at full load during twelve hours consecutively, of more than 45 C. above the surrounding air.

Arc Lamps.—There shall be 194 alternating current, 60 cycle, 12 hour open arc lamps. Each arc lamp will be of nominal 2,000 c.p., and consume not more than 500 watts per lamp. There will also be 320 incandescent lamps of 16 c.p. each.

CANADIAN ENGINES IN SPAIN.

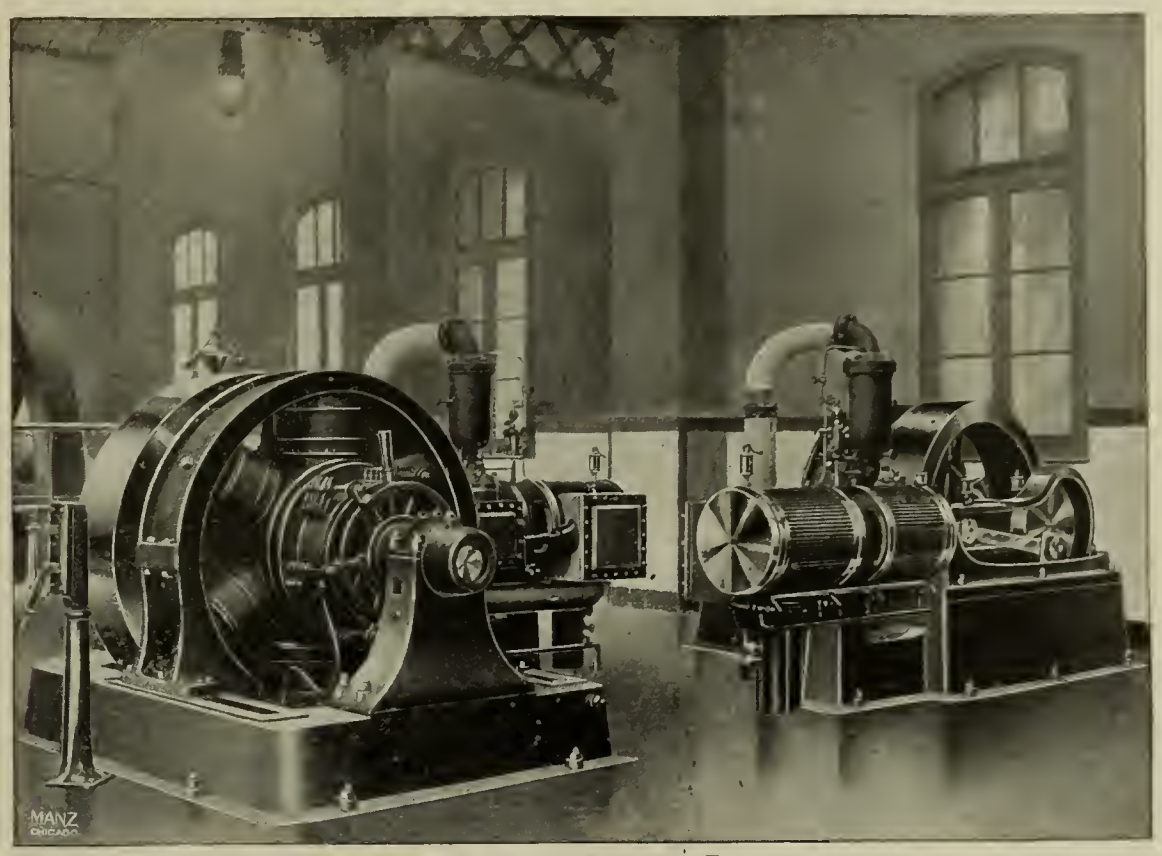
In October, 1897, contracts were given for the equipment of electric tramways in Barcelona and Madrid, the two most important cities in Spain. The work was completed a few months ago and the lines are now in successful operation. Barcelona with a population of about 600,000 is the largest city in Spain, and is an important seaport and manufacturing centre. It is an ideal city in many respects but particularly from the standpoint of the owners of the electric railway, as it is well patronized on account of the climate being too warm for walking. Madrid is the capital of Spain, and is nearly as large as Barcelona. It is situated inland, and has many parks, broad streets and fine buildings. In the character of its population it resembles a western American city, as not more than 40 per cent. of its residents are natives. Although these systems are owned by British capital and built by British contractors, much of the apparatus was purchased on this side of the Atlantic. The main engines were manufactured in the United States, and three smaller engines were supplied by the Robb Engineering Co., Amherst, N.S. These engines, as shown in the accompanying illustrations, are tandem compound, of the side crank type with dynamos direct connected. They were put in principally for lighting the extensive car sheds and driving the machinery in the workshops connected with the tramway systems, but are also used for running part of the cars late at night or early in the morning when the main engines are shut down. The high pressure cylinder of these engines is 10 inches in diameter, low pressure 16 inches in diameter, stroke 15 inches, and they are rated at 115 h.p. each. Both valves are controlled by the automatic governor in such a way as to divide the work equally between the two cylinders. The crank shaft, connecting rod and crank pin are of hammered open-hearth steel. The high pressure cylinder is placed next the frame, the low pressure in the rear so that the cylinder heads and pistons can be removed without disturbing the cylinders. The throttle consists of a flat valve rotated through one-half revolution by a lever, and as the valve and seat are protected from the steam whether open or shut they can neither wear nor rust. The main bearings have a ring oiling device, the oil being continuously conveyed from a cavity beneath the bearing to the top of the shaft by metal rings which



Robb-Armstrong Engine at Madrid.

dip in the oil. All bearings are large and the parts of the engines few and simple, and as strong as possible, making them well adapted to any service where continuous running and variable or severe work is required.

It is highly creditable to the Robb Engineering Co. that its engines were selected as part of these installations, which



ROBB-ARMSTRONG ENGINES AT BARCELONA.

are said to be the most important undertakings of the kind completed in any part of the world during the year 1898. The products of this firm have been favorably known throughout Canada for a number of years, and we have no doubt the foreign shipments, which have been quite numerous during the past year, will give as great satisfaction and lead to a large increase of business.

MINING METHODS.

Editor CANADIAN ENGINEER :

Would you kindly give me some information through your valued monthly in regard to placer mining, panning, sluicing, etc. J. H.

North Bay, Ont.

[Placer mining is only practicable where free gold is deposited in beds of sand and gravel. The sand underlying the gravel of streams is the most likely place, and the gold will be found—owing to its great weight—where eddies or bends in the stream check the speed of the current, thus allowing the gold to settle. The most simple way of extracting gold from the sand is by panning. A shovel full of sand is placed in the pan, which is a steel dish, shaped very much like a frying pan, about 15 inches wide and 3 inches deep, with sloping sides. The loose, light mud is then washed out with water, and the large pebbles removed by hand. The sand is then subjected to washing, which is done by giving the pan a circular motion, and adding water at the same time; in this way all the light sand is washed over the edge, leaving behind a heavy residue, mostly black iron ore, and the gold. If the gold is in fairly large nuggets it can be extracted by further panning, as it is so much heavier than the black sand, but if it is in a fine state it will have to be treated with mercury, this is done by mixing the sand thoroughly with mercury, and squeezing in a buckskin bag, thus freeing the mercury from the alloy. The gold can then be extracted from the alloy by heat. Skill in panning can only be obtained by considerable practice. In the case of a large deposit of auriferous gravel the best way to treat it—if circumstances allow—is by hydraulicing; this is done by playing a stream of water, under considerable head, upon the gravel deposit, which will be carried by the water through a number of sluices, which are large, frame troughs lying on the ground and paved with wooden blocks or riffles, which are fit to catch the gold and amalgam. The sluices are slanted according to the nature of the gravel worked and the supply of water, and are made long enough so that a test of the balings being taken, no gold will be found. The supply of water must be sufficient to cover the largest boulder met with, and is supposed to carry away 1-5 its own weight in gravel. Mercury is added several times daily at the sluice head. The stream of water, sometimes under a head of 400 feet, is directed by a nozzle (monitor), of from 5 to 9 inches in diameter. When it is time for a "clean up" the water is turned off, all the loose gravel picked out and the gold and amalgam carefully collected. Under favorable circumstances gravel running as low as 2 to 3 cents per cubic yard can be treated with profit by this method. The gold rocker is such a crude home-made affair that it is difficult to get cuts of it, but it may be found in some text-books on gold mining, for instance in "Gold (Metallurgy of)" by T. H. Rose. Roughly, it is a wooden box, 3 feet long by 1½ feet wide, one side being knocked out, and resting on two rockers, one of which is lower than the other, thus giving the floor a slant from back to front. About two feet above the floor is a removable riddle box, 3 feet long by 9 inches wide, with ½ inch mesh screen; below the riddle and forming an angle of about 30 deg. with it, and slanting toward the back of the rocker, is stretched a piece of blanket or canvas apron, the length of the rocker and about 10 inches wide. The gravel is placed in the middle box with water, which washes it through into the apron; here the fine gold is caught, and the dirt passes out from back to front over the bottom where the heavy sand and coarse gold is caught by two or three riffles nailed across the bottom. Mercury is sometimes added. The object of the rocking motion is to prevent the sand from packing behind the riffles. The capacity of a rocker of this description—two men washing—is from 3 to 5 cubic yards per day; the amount of water used is 3 or 4 parts to 1 of gravel.—ED. CAN. ENG.]

DAM BUILDING.

Editor CANADIAN ENGINEER :

Your January number contains an article upon dam construction by Chas. Baillairge, which opens up discussion upon a subject which is of great importance at a time like the present, when so much capital is being invested in the development of water power plants in all parts of the country. Mr. Baillairge, quite rightly, in my opinion, advocates the use of concrete for such works. In approaching the question of ratio of thickness to depth of water, however, it will be necessary to take into account some other factors in the problem which Mr. Baillairge has not embraced in his statement of the matter. The length of the structure should be considered as well as the depth of the water. About 1-10 of the length will figure out a good proportion for dams of moderate length, provided this is not less than .5 of the depth of water. This width being increased by footing courses so as to give a total width of effective base to resist overturning equal to .8 of the depth of water. The proportion of .5 however, should be maintained to the top of the

dam, and the dam should not be tapered off at the top as is the customary practice. By building the dam of a uniform thickness, the structure is much better equipped for resisting the action of moving loads, and it is my belief that engineers will fail in the search for a satisfactory formula for the strength or proportioning of dams, until they recognize the presence of moving loads upon such structures. It has long been known that the stresses caused by the moving loads were the most destructive in the cases of bridges and buildings, and it will have to come to the same point in regard to dams. The arched design spoken of by Mr. Baillairge is of doubtful advantage. If it is properly equipped at the abutment ends for receiving thrust, it may possibly contrive to act as an arch, but if the same amount of material were put into a straight dam, and the transverse section so designed as to enable the structure to resist moving loads, it would be a much better dam than the more slender extended structure in the form of an arch would ever be.

Yours truly,
JNO. S. FIELDING.

3606 Boquet St., Pittsburg, Pa., Mar. 14th, 1899.

A STUDY OF EMERY WHEELS.

Emery wheels that were thirty years ago practically unknown and forty years ago not manufactured, are to-day an article understood by everyone who knows the uses of a grindstone. Emery is a mineral; the best quality, and that which is used almost exclusively being found in Turkey. The Canadian trade is supplied by United States and English mills which crush and grade it, at the same time clearing it of impurities. The manufacturing of wheels is done by a variety of processes, many of which are adapted only for special varieties of grinding. The wheel that is most called for and which must be of good quality to prove a labor-saving and durable article is a general purpose wheel. What we mean by a general purpose wheel is one for coarse work, such as castings, steel, and all kinds of metal. The two varieties of wheels which have heretofore principally been used for this purpose are what is known as the "Vitrified" and "Silicate." The "Vitrified" wheel is taken from the same process as a brick-maker would make brick, with various alterations to make it much harder and hold the

emery up to its work to give it cutting properties. This has proved itself to be a very good process, but being of a glassy nature it is very liable to break, and thus has to be used with caution. The high speed at which it has to run to prove a good cutting wheel also proves a detriment to its use. The "Silicate" may be said to be the first and last, being in use for a great number of years it is yet more used as a general purpose wheel than that of any other process. The chief ingredient in the bond of this wheel is silicate of soda, sometimes known as "liquid glass," commonly called silicate. This can be used with safety, as a defective wheel can easily be detected, it is claimed, by tapping it gently with a hammer, if cracked or defective in any way it will give a dull sound, whereas a good wheel will ring sharp and clear.

Some two years ago a combination of the "Vitrified" and "Silicate" wheel was attempted by the Prescott Emery Wheel Co., limited, and they have now on the market a wheel known as the "semi-vitrified" wheel, which contains the good qualities of the two already referred to, together with its own advantages. It is said to be waterproof, can be used wet or dry, the bond being of such a nature that it has cutting qualities as well as the emery contained therein. It is perfectly safe, as it can be tested, which, it is claimed, cannot be said of the "Vitrified" wheel, and has advantages over the "Silicate" wheel inasmuch as the bond therein contains no cutting qualities which clog the faces of the particles of emery, causing it to glaze and burn the work instead of cutting it. The semi-vitrified always has a cutting surface, which cuts very fast and cool. The manufacturers claim that this process is rapidly taking the place of the other two processes mentioned, as the results wherever they are used show forth.

To procure the greatest amount of work from an emery wheel and ensure safety in running, only the best grinders should be used. The arbor should be of sufficient proportion to easily carry the wheel adjusted on it. The following table will give an idea of the correct size of arbor: Wheels 6 in. in diameter and less, ½ in. arbor, 7 to 10 in. inclusive, ¾ to 1 in.; 12 to 14 in., 1¼ in.; 16 to 18 in., 1½ in.; 20 to 24 in., 1¾ to 2 in. In mounting a wheel, it should slip on the arbor easily, never force it on the arbor. Keep boxes of machine tight, so as arbor will not jump. Keep rests close up to wheel. The collars should be one-third the size of the wheel. and made slightly concave to touch the wheel only at their circumference; washers of paper or some other pliable nature should be used between the wheel and collar. All our wheels are supplied with circular labels which serve to protect the wheel in this capacity. The cutting surface of the wheel, to give good satisfaction, should be kept true. This can be done with a dresser or diamond tool. All emery wheels should be run at a surface speed of 5,500 feet per minute. By running at speed marked on the label of every wheel, this can be attained. Running faster than this speed will cause it to glaze, burn the work and a certain risk is involved. By running too slow, it wears the wheel unnecessarily and does no more work. The Aikenhead Hardware Co., Toronto, carry a full line of wheels of the Prescott Emery Wheel Co.'s manufacture.

TABLE OF EMERY WHEEL SPEEDS.

Diam. Wheel.	Rev. per Min. for Surface Speed of 4,000 ft.	Rev. per Min. for Surface Speed of 5,000 ft.	Rev. per Min. for Surface Speed of 6,000 ft.
1 in.	15,279	19,099	22,918
2 in.	7,639	9,549	11,450
3 in.	5,093	6,366	7,639
4 in.	3,820	4,775	5,730
5 in.	3,056	3,820	4,584
6 in.	2,546	3,183	3,820
7 in.	2,183	2,728	3,274
8 in.	1,910	2,387	2,865
10 in.	1,528	1,910	2,292
12 in.	1,273	1,592	1,910
14 in.	1,091	1,364	1,637
16 in.	955	1,194	1,432
18 in.	849	1,061	1,273
20 in.	764	955	1,146
22 in.	694	868	1,042
24 in.	637	796	955
30 in.	509	637	764
36 in.	424	531	637

OUR FRIENDS SAY SO.

[Copy].

Depot Harbor, February 3rd, 1899.

Biggar, Samuel & Co., Fraser Building, Montreal, Que.

Dear Sirs.—Enclosed find $1, my subscription to Canadian Engineer for the year 1899. I like your paper, it contains a lot of information which is valuable to know and I would miss it if it were stopped. Wishing you a greater amount of success this year than ever before, I remain, yours truly,

D. S. LOUGH.

P.S.—Please address my paper to 354 Elgin street, Ottawa, Ont.

D. S. L.

[Copy].

The Riordan Paper Mills, Ltd.

Merritton, February 4th, 1899.

Biggar, Samuel & Co., Fraser Building, Montreal, Que.

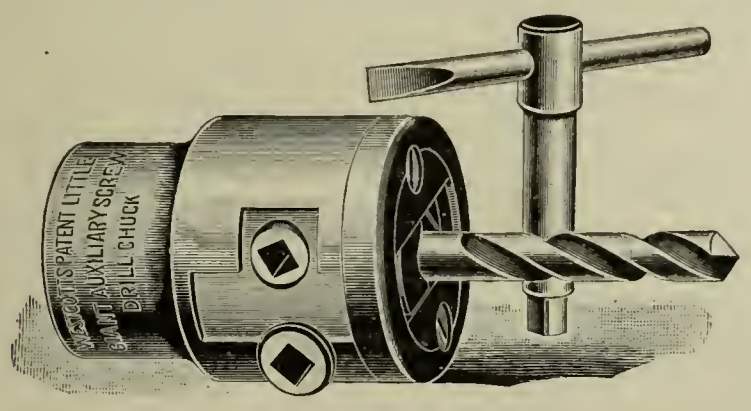
Dear Sirs.—I take pleasure in remitting you by P.O. order

my subscription for The Canadian Engineer for the ensuing year to December, 1899. I consider this dollar better spent than most. Your paper surpasses any trade papers I have seen, in value of contents and its attractive style. I am glad it is "Canadian." Yours sincerely,

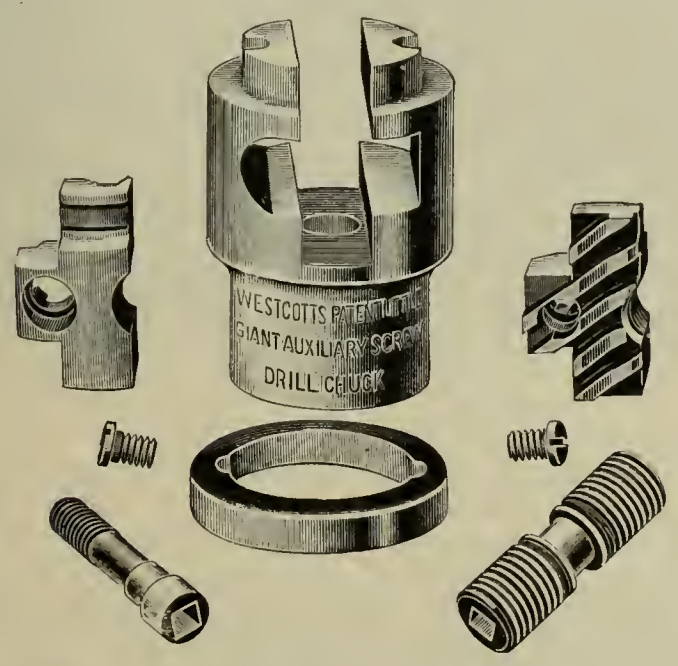
CHAS. C. RIORDON, JR.

LITTLE GIANT AUXILIARY SCREW DRILL CHUCK.

In addition to the popular Little Giant Improved, Little Giant Double Grip, and Oneida Drill Chucks, and Lathe Chucks of all kinds, the Westcott Chuck Co. is now furnishing the Little Giant Auxiliary Screw Drill Chuck, as shown in illustration. In drill chucks with side screws it is claimed that the inner or gripping part of jaws has a tendency to crowd away from the right and left hand screw, and the outer end of



jaws has a tendency to draw toward the right and left hand screw. The auxiliary screw (in this new Little Giant Auxiliary Screw Drill Chuck) entirely overcomes said tendencies. After closing jaws on drill in the usual manner (by turning right and left hand screw), then tighten the auxiliary screw. This will greatly increase the gripping power of chuck. The effect of the auxiliary screw is similar to that of a bolt, as it virtually bolts the two jaws together. The ½-inch, ¾-inch and 1-inch sizes are made of pattern shown in the figures. The hole in the hub is made to fit the Morse taper, but can be bored out



and threaded to suit the customer's templet at small cost. These chucks are also made with straight bodies, which are especially adapted for Hollow Spindle Lathes, for holding rods, round or square, which are to be turned or cut off. When a chuck is wanted for holding square work it should be so stated in order. The Aikenhead Hardware Co., Adelaide street, Toronto, reports a steady and increasing demand for the Westcott chucks.

NEW CATALOGUES.

The following catalogues have been received and are filed in our office, where they may be consulted at any time:

The Unbreakable Pulley and Mill Gearing Co., Ltd., West Gorton, Manchester.—A Treatise on the Economical Transmission of Power. Eighth edition. Cloth covers, 160 pages.

Darling Bros., Reliance Works, Montreal, Que.—Illustrated catalogue of Darling Bros., Reliance engineers, machinists and manufacturers of special and patented machinery. Boards, 100 pages.

Prescott Emery Wheel Co., Ltd., Prescott, Ont.—Catalogue and Price List No. 16.—Paper, 40 pages, illustrated. Attention is called to some new features, as the "Semi-Vitrified," which is more open in texture than the other wheels, and which has an abrasive bond.

Gas and Gasoline Marine Engines and Launches.—The John Gillies Estate Co., Carleton Place, Ont.

The Gartshore-Thompson Pipe and Foundry Co., Ltd. Hamilton, Ont.—Catalogue of cast-iron pipe (3 inches to 60 inches in diameter), for water, gas, culverts and sewers; also special castings, hydrants, valves, etc.

The Michigan College of Mines, Houghton, Mich., U.S.A.—The catalogue of the Michigan College of Mines, with statements concerning the institution and its courses of instruction for 1898-1900.

The Lehigh University, South Bethlehem, Pa., U.S.A.—The Register of Lehigh University, South Bethlehem, Pa., U.S.A.

The Massachusetts Institute of Technology, Boston. Annual Catalogue, 1898-1899; paper, 350 pages.

The Fairbanks Co., Montreal.—Illustrated Supply Catalogue; cloth, 250 pages; profusely illustrated, showing a full line of the varied mill supplies carried by this well-known company.

ROLLING OR RAMMING IN ROAD BUILDING.

Editor CANADIAN ENGINEER:

Sir,—There is one thing as to which the profession is entirely in the dark, and where information is capable of being afforded by such an institution as McGill University, under Professor Bovey's able direction, and supplied as the institution is, avowedly, with all the necessary and the best and most suitable machinery for the purpose. I allude to comparative statistics of ramming and rolling for purposes of street paving. What amount of pressure is equivalent to a blow from a hammer or pounder of a given weight, lifted by the operator to and descending from a certain height. In a word what weight of a road roller exerted on a given surface is equivalent to ramming the same in an efficient manner. Maybe an inkling of it might be obtained by estimating the force of impact used in driving a nail into a piece of soft or ordinary wood, and the pressure in pounds to be exerted to drive another nail in the same time to the same depth.

This question of ramming vs. rolling a road-bed or of rolling vs. ramming is most pertinent; and though of extreme intricacy, considering the rather indefinite breadth and area of the strip of surface on which the roller bears; still I am confident Mr. Bovey can make something of it and give us at least, and as soon as possible, to begin with, in view of the approaching season for paving, some approximate mode of being satisfied, which I am prone to believe that almost no imaginable weight of road rollers (10 tons, 20 tons or more) can be nearly as effective as ramming.

Another question to which I would invite your attention is a statement of the depth to which an impacting of the surface, or a rolling of it, will reach, in an effective manner. Of course, we know that in trench filling, the ramming amounts to nothing if left to be performed only when the trench is filled, and the filling should be rammed, in successive layers of six to eight inches it is supposed, and this is the practice followed out in embanking for reservoir dams; but still it is guess work more or less, and has not been calculated and reduced to a science as it should be, if possible. In trench filling, here in Quebec, by our gas company, when it excavates for any purpose, a man goes and comes along the bottom of the trench as it is being filled in from above, and in such a way as, by allowing say one rammer to half a dozen fillers, to ram almost every successive shovelful of filling as it goes down. This, of course, is the right thing to do, or should be, but could hardly be expected, over extended areas.

A heavy (steam) road roller is most deceptive. It inspires the general public with full confidence in its efficiency; but we are not, in such matters, to be guided by mere sentiment. Very little is known of the comparative effect of rolling and ramming. I have just now before me paving specifications, best or most recent editions of them all, from Washington, New York, Boston, Baltimore, Philadelphia and Chicago, and they are all at one in specifying "ramming or rolling with a 5 to 10

ton roller," as if the one were equivalent to the other. Now on the contrary, I do not know that even a 50-ton roller, which it would be impractical to use, would be an equivalent. I am far from stating this; having no data to go by, but suppose a rammer be 6-inches square, or of an area of 36 inches, and suppose a roller is 5 feet long or broad, and 5 feet in diameter, and weighs 10 tons, then will there be but one ton weight or pressure on every 6 inches lineal of the length or breadth of roller. Suppose, now that the effective breadth of the strip of surface pressed on by the roller be 6 inches, and it hardly could be less, on an already rolled surface, or after a first or second rolling without a versed line of sinkage into the surface to an extent to widen the cord of section of area sunk into by the roller. I say that in such a case, only one-tenth of weight of roller would come upon this surface or area of 6-in. by 6-in. or 36 square inches, and a comparison is now to be instituted, in how far this weight of one ton on one-quarter of a square foot is equivalent to a blow or succession of blows of a rammer of given weight falling from it or brought down like a hammer with a man's muscular effort in addition to the effect of its own or unaided weight or impact.

C. Baillairge,
Quebec, March 23rd, 1899. Consulting Engineer.

HARRIS VS. THE TORONTO ELECTRIC LIGHT CO.

The verdict against the defendant in Harris vs. the Toronto Electric Light Co. marks the first step in a legal fight which will be watched with absorbing interest by everyone interested in electricity, either as producer or consumer. The number of double services such as is alleged to have caused the fire is very great, and all producers of electric current will feel most insecure until the finding of the Court in this case has been reversed as no doubt it will be when heard before a Court which will go fully into the technical points involved. The plaintiff's witnesses swore that they saw the wires fire the building. Such a result would only be produced by a short circuit of course. The defendants showed that the fire alarm sent in by telephone by Dr. A. A. Macdonald, who saw the fire in the interior of the building, was given at 2.35, and the short circuit was recorded at the defendant's works as occurring at 2.48. The verdict was for $10,000 damages.

The whole of the evidence in this interesting case will be reviewed in a later issue.

ONTARIO RAILWAY GRANTS.

The following bonuses have been granted by the Ontario Government:

To the Ontario, Hudson Bay & Western Railway, between Missinabie Station on the Canadian Pacific Railway and tidewater on the mouth of Moose River on James Bay, a distance not exceeding two hundred and forty miles, a cash subsidy of $2,000 a mile—$480,000.

To the James Bay Railway, from a point at or near Sudbury to a point at or near Lake Abittibi, a distance not exceeding one hundred and seventy-five miles, a cash subsidy of $2,000 a mile—$350,000.

To the Haliburton, Whitney & Mattawa Railway, between Haliburton and Whitney, a distance not exceeding thirty miles, a cash subsidy of $3,000 a mile—$90,000.

To the Ontario & Rainy River Railway, from its junction with the Port Arthur, Duluth & Western Railway to Fort Frances, a distance not exceeding two hundred and five miles, a cash subsidy of $1,000 a mile, and from Fort Frances to the mouth of Rainy River, a distance not exceeding seventy-five miles, a cash subsidy of $4,000 a mile—$505,000.

To the Central Ontario Railway from Ormsby or Coe Hill to a point at or near Bancroft, a distance not exceeding twenty-one miles, a cash subsidy of $3,000 a mile—$63,000.

To the Central Counties Railway from Glen Robertson to Vankleek Hill, a distance not exceeding fourteen miles, a cash subsidy of $2,000 a mile—$28,000.

To the Ontario, Belmont & Northern Railway, from the northern terminus thereof in the direction of the townships of Belmont and Lake, a distance not exceeding seven miles, at the rate of $3,200 a mile—$22,400.

Resolved, That there shall be set apart for the use of the Sault Ste. Marie & Hudson Bay Railway and the James Bay Railway out of the lands of the Crown through which they may pass, 5,000 acres to the mile of each of the said railways for the portions above mentioned, such areas to be selected in blocks of 5,000 acres on each side of the line alternately by taking the necessary number of lots as the townships are surveyed or outlined, or by taking the proportionate grant for each ten miles of railway (or 50,000 acres) in blocks on alternate sides of the line, such blocks to have a frontage on the line of ten miles each, or in such other way as may be agreed upon by the said company and the Lieutenant-Governor-in-Council.

THE BICYCLE INDUSTRY.

During the last five years Canada has come to the front in a remarkable way in the bicycle industry. Last year this journal gave several instances of large shipments of Canadian-made bicycles to foreign countries and the British colonies, as well as to Great Britain itself. That Canadian manufacturers are doing their best to maintain their position in this branch of trade was made evident to a representative of The Canadian Engineer, who in company with a number of other journalists paid a visit the other day to the bicycle factory of H. A. Lozier & Co., Toronto Junction, makers of the Cleveland wheel. The extensions built to these works during

Sand Blasting Department.

the past year have enabled this company to double its output—which is now from 150 to 200 wheels per day. The various departments have an aggregate floor space of 137,000 square feet, and with the exception of the wood rims and rubber goods all parts of the Cleveland wheel are made in the firm's own works. In addition to its own steam plant the company has its own electric lighting plant, and its own gas plant, supplying fuel oil and gas for various departments. There are two oil tanks with a capacity of 5,000 gallons each. The works have their own water supply also, there being a roof tank of 10,000 gallons capacity, and an underground tank of 100,000 gallons capacity. The brazing of the bicycle frames is carried out chiefly by the "dip" process, ensuring uniform and rapid work. For removing the borax and encrustations the sand blast is used instead of the "pickle," commonly applied after brazing. The sand blast has the advantage not only of rapidly and completely cleaning the brazed parts, but the fine frosting which it gives to the entire frame enables the rust proof coating and subsequent enameling coats to adhere with greater tenacity. A view of the sand blast room is here given. It contains five sand tanks, to each of which is attached a pipe ending in a funnel which discharges the sand in a thin stream on the principle of a sand hour-glass. An air compressor supplies the air blast to each operator through a flexible tube which ends in a nozzle, manipulated by the operator as the nozzle of a fire hose would be. The operator's eyes are protected from the rebounding particles of sand by a canvas screen in which a pane of glass

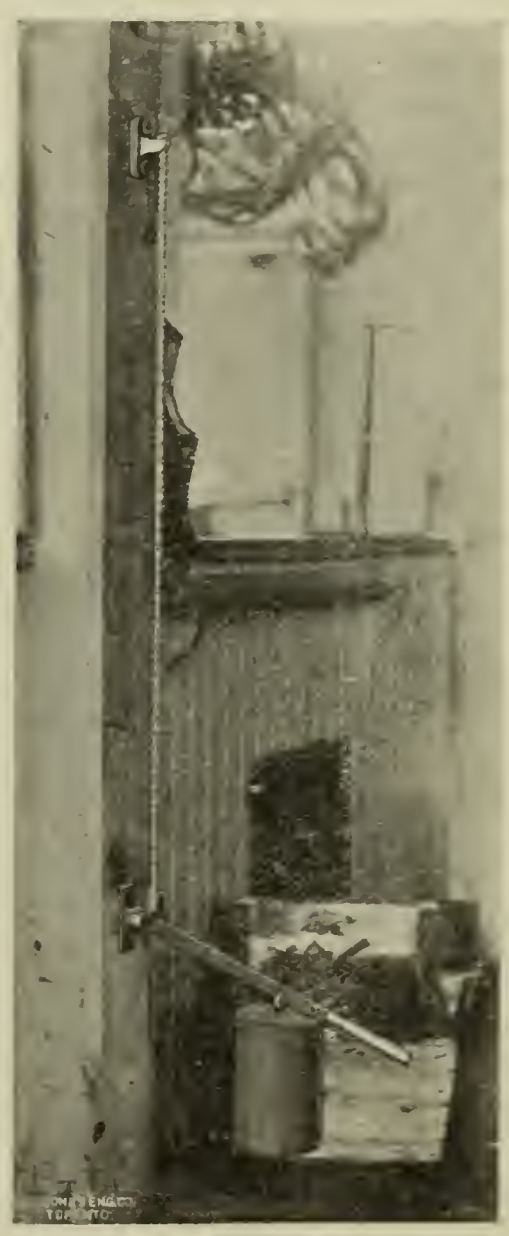
is fitted to enable him to see his work. Armholes are cut in the canvas so that he can hold the frame with one hand, and direct the stream of sand by means of the hose in the other hand. The blast of air is brought in under a pressure of 15 lbs., this being sufficient to drive the fine grains of hard sand with such force as to impart a fine frosting on the smooth tubing almost instantly. This is a hard silicious sand, imported from St. Louis, the Missouri sand being the best yet discovered for the purpose. Previous to being enameled the frames are primed with a special rust-proof composition. The enameling room has four double "dips," each tank holding 120 gallons of

Drop Forging Department.

the enamel, and there are 10 furnaces, heated by fuel oil to a temperature of about 340 degrees for the baking of the enamel, which is put on in four coats. The blue dipping room for putting on the blue dip, which is the distinguishing feature of the Cleveland spokes, has a capacity for dipping spokes in lots of 5,000 at a time. A great amount of special machinery is used for the rapid production of the various parts of wheels, such as the pedals, cranks, hubs, chains, gear wheels, etc., and each part as it is completed is tested by automatic machinery, except the pedal cranks, which are tested by hand. For instance, a chain when finished is put into a device (shown in the engraving), by which it is subjected to a strain of 1,000 lbs. by means of a weight. Having been thus tested for strength the chain is put on a pair of sprocket wheels revolving at such a rate as would be equal to a run of 200 miles in a few minutes.

Sprocket Testing.

and thus every link is put in the most thorough running order. So with the pedals, which after being put together are placed on the testing machine, here illustrated, and spun in a bath of oil at the rate of 3,000 revolutions per minute to prevent any possible unevenness. The machine tool room is very completely equipped. It contains a planer, 5 shapers, 2 milling machines, 15 lathes, 1 speed lathe, 50 vises, 1 die sinker, 1 universal grinder, 1 cutter grinder, 6 drill presses and many other machines; while the milling, drilling and punch press room contain 24 plain and universal machines, 15 drill presses, 10 punch presses and other special machines. The lathe department contains 21 screw machines, 10 lathes, 3 grinders and other machines. The air compressor used is from the well-known works of the Canadian Rand Drill Co., Sherbrooke. The company employs at Toronto Junction 350 to 500 hands, but the hands in the United States and Canadian works aggregate over 2,000, with a total production of 500 wheels per day. The works are under the able management of E. R. Thomas



Chain Testing Machine.

Signor Cuigliemo Marconi, the inventor, who recently, after long delay, obtained permission from the French Government to establish a station on the French coast for the purpose of experimenting with wireless telegraphy between England and France, announces that he has conducted successful

Crank Testing

experiments between the South Foreland, county of Kent, and Boulogne-sur-Mer, 32 miles. The Times, March 29th, printed a hundred-word despatch, the first press message by the Marconi system of wireless telegraphy, describing the experiments between the South Foreland and Boulogne-sur-Mer. The experiments were carried out in the Morse code, and were read as distinctly as if wires were used.

Industrial Notes.

Toronto is advertising for tenders for a gas plant for Toronto Island.

The Niagara Falls Planing Mill Co., Ltd.; capital, $3,500, has been incorporated.

The town of Windsor, N.S., has voted $2,000 for a site for a public building; $5,000 for the building and $5,000 for a steam fire engine.

The Dodge Mnfg. Co., Ltd., Toronto, is working a large staff of employees full time, turning out pulleys and rope drives, etc.

Vancouver, B.C., has ordered a No. 5 Champion rock crusher with elevator and screen from the Good Roads Machinery Co., Hamilton, Ont.

Shurley & Dietrich, Galt, Ont., have, it is said, decided to move their iron bedstead factory, now at St. Catharines, to Galt shortly. A new building will be erected.

The R. Simpson Co., Ltd., department store, Toronto, has bought the corner of Richmond and Yonge streets, and will build a large extension to the store at once.

Listowel, Ont., is organizing a co-operative pork packing establishment, whose proposed capital is $37,500, and also a furniture factory to be heavily bonused by the town.

Tenders are called for the construction of a system of waterworks for the village of Hintonburgh, Ont., as will be seen by reference to the advertisement in another column.

The Middleton, N.S., Outlook reports that the people of Berwick, N.S., are considering the advisability of starting a cannery in connection with the creamery already established there.

The McClosky Wire Fence Co., Ltd., Windsor, Ont., has been incorporated with a capital of $40,000. The provisional directors are: W. McClosky, J. R. Dixon, J. A. Auld, S. A. King, M.D., and J. Kay.

J. O. C. Mignault, C.E., has entered an action claiming $5,000 damages from the corporation of Roberval, Que., on account of a protest served upon him in connection with certain work which he did for the municipality.

W. H. Comstock, J. McL. Gill, G. I. Mallory, E. W. McCrea, O. K. Fraser, Brockville, Ont., and J. Cumming, Lyn, Ont., have been incorporated as the Brockville Peat and Power Company, Ltd.; chief place of business, Brockville, Ont.; capital, $99,000.

H. P. Dwight, W. D. Matthews, R. Jaffray, E. B. Osler, G. A. Cox, Fred. Nicholls and J. K. Kerr, Toronto, are the directors of the Motor Carriage Co., of Ontario, Ltd., which has been organized to make, and sell, and let for hire motor carriages and other vehicles; chief place of business, Toronto; capital, $250,000.

The Montreal Pipe Foundry Company, together with C. A. Meissner, have leased the works of the old Londonderry Iron Company, situated in Colchester county, N.S. The new company will, like the old, manufacture cast-iron water pipe and other cast-iron fittings. Mr. Meissner was the general manager of the old concern.

The B. Greening Wire Co., Hamilton, Ont., has just closed a contract for the erection of a new wire cleaning house, which will enable it to greatly increase the output of the wire drawing mill. During the building of this addition there will be added thirty feet to the smoke-stack, it being the intention to increase the power by the addition of 100 h.p., either electric or steam, as may be decided.

The reports of the British Fire Prevention Committee continue to be of great interest. No. 14, just received, contains the statement of a test made by the committee upon a floor built by the Expanded Metal Co., Ltd., London. In this test a room lined with expanded metal lathing and floored with concrete laid upon expanded metal, withstood a temperature of 2,000 deg. for an hour, and only showed slight cracking when water was thrown from a hose at 20 lbs. pressure for three minutes.

E. H. Bronson, F. P. Bronson, W. G. Bronson, Levi Crannell, Ottawa; T. L. Willson, Woodstock, Ont.; J. Sutherland, M.P., Woodstock, and J. J. Gormully, Ottawa, are applying for incorporation as the Ottawa Carbide Company, Ltd., to manufacture calcium carbide at Ottawa, with a capital of $200,000. It is said that the large sawmill premises of Bronson & Weston with its valuable water power will be used for the purposes of the company.

R. M. Thompson, New York; J. J. Thompson, Bayonne, N.J.; J. R. Wilson, Montreal; C .C. Colby, Stanstead, Que., and R. G. Leckie, Esq., Truro, N.S., are applying for a Dominion charter as the Canada Mining and Metallurgical Company, Ltd., to carry on exploring for mining, smelting, treating, manufacturing, extracting, reducing and selling gold, silver, copper, lead, iron, tin and other ores, metals and mineral substances. Chief place of business, Montreal; capital, $5,000,000.

The Fairbanks Co. has placed a large stock of its scales with Miller, Morse & Co., of Winnipeg, who will handle Fairbanks' standard scales, gasolene engines, and some of the other specialties of the Fairbanks Co. for Manitoba and the Northwest Territories. They will constantly carry in stock a full assortment of goods most commonly called for, and all enquiries for these products for this territory should be sent to them. The Fairbanks Co. is extending its business rapidly and while covering new territory accounts for some of the increase, the satisfaction experienced by former clients is a much greater source of the firm's development.

The Dominion Iron & Steel Company has been granted by the Nova Scotia Legislature a partial exemption from payment of royalty on coal used in the operations of the company, which has just been incorporated with a capital of $20,000,000. H. M. Whitney, Boston, who is head of the new company, as well as the Dominion Coal Company, asked for entire exemption from payment of the provincial royalty for a period of five years on the coal used by the Iron & Steel Company, and the Government granted half the exemption for eight years. The Dominion Coal Company pays a royalty of twelve and a half cents a ton. The Dominion Iron & Steel Company will use enormous quantities of coal.

Electric Flashes.

A. and G. Cornell are establishing an electric light plant at Stanbridge East, Que.

Quyon, Que., is to have electric light and a large grain elevator in the near future.

The Richelieu & Ontario Navigation Co. is placing a lighting plant in its hotel at Tadousac.

The Welland-Vale Co., St. Catharines, has recently installed a lighting plant in its bicycle factory.

The electors of Winnipeg will vote this month on a by-law providing for a municipal electric light plant.

The Canadian General Electric Co., Ltd., is installing an 800 light alternating dynamo for Jas. Knox, of Stayner, Ont.

The Montreal Novelty Co. has placed an order with the Canadian General Electric Co. for a 6 k.w. Edison generator.

The Radial Railway repair shops at Hamilton Beach were destroyed by fire, March 13th; damages, $4,500; fully insured.

The University of New Brunswick has purchased an experimental electric plant from the Canadian General Electric Co., Ltd.

Jos. Knot, Stayner, Ont., proposes to develop power on the Nottawasaga river for lighting and industrial purposes generally.

A project is on foot to build an electric railroad between Trenton and Westville, Pictou county, via New Glasgow and Stellarton.

The people of Cornwall, Ont., are making strong representations to the Government to secure an effective head of water for power development in the improvements being made in the Farran's Point canal.

The award in the Brantford, Ont., Electric Co. and Robson Bros. arbitration has been handed down and gives Robson Bros. $4,195.

The Penman Mnfg. Co., of Paris, Ont., is adding an 8½ k.w. generator of the Canadian General Electric Co.'s make to their present plant.

Cunliffe & Ablett, Vancouver, B.C., have bought from the Canadian General Electric Co., Ltd., two 50 h.p. three-phase induction motors.

The Hull and Aylmer, Que., Electric Railway Company has decided to equip its cars with new gearing so that they will run at forty miles an hour.

The Guelph Street Railway Co. has placed an order with the Canadian General Electric Co., Ltd., for a multipolar railway generator of 110 k.w. capacity.

The Montreal Street Railway Co. has placed an order with the Canadian General Electric Co., Ltd., for ten more two motor G.E. 1,000 motor equipments.

The street railway line is to be extended to English Bay beach, the Vancouver city council having granted the necessary franchises renewable every five years.

The Department of Railways and Canals has placed an order with the Canadian General Electric Co., Ltd., for additional plant to be used on the canal at Sault Ste. Marie, Ont.

The Kootenay Standard Publishing Company, Rossland, B.C., is placing in its printing house one of the Royal Electric Company's "S.K.C." induction motors to operate the printing presses.

F. H. Daigneault, M.D., J. E. Marcile, L. S. Plamondon, E. St. Amour and E. Tetreault, Acton, Que., have been incorporated as the Acton Hydraulic Power Co., with a capital of $15,000; headquarters at Acton.

The Kentville, N.S., Electric Light and Power Co. is installing, as an increase to the present plant, two multipolar generators of 45 k.w. each, which will be supplied by the Canadian General Electric Co., Ltd.

The Lindsay Light, Heat & Power Co. has placed an order with the Canadian General Electric Co., Ltd., for one multipolar generator of 25 k.w. capacity, which is intended as an addition to the present power plant.

It is stated that the various electric companies doing business in Montreal in lighting, power distribution and passenger transportation, will be amalgamated with a probable capital of ten or fifteen million dollars.

The Richelieu & Ontario Navigation Company are installing complete lighting outfits on two of its boats, consisting of Canadian General Electric Company's multipolar generators of 30 k.w. capacity directly connected to high speed engines.

The Canadian Brotherhood of Electrical Workers elected the following officers for the year at a recent meeting in Toronto: President, T. Eaton; vice-president, S. P. Kent; recording secretary, J. C. Long; financial secretary, F. Marson; treasurer, F. Hawkey.

W. A. Johnson, J. W. Thompson, J. N. Smith, G. E. Scholey, Erie Thompson, C. J. Holman and A. B. Lee, Toronto, have been incorporated as the United Electric Co., Ltd., to carry on the business of the W. A. Johnson Electric Co., and the Toronto Electric Motor Co., Ltd.

A. S. Bowen, Kemptville, Ont., has purchased the lighting plant recently operated by Mr. Collins of that town, and is installing a standard 1,000 light alternator of the Canadian General Electric Co.'s make, together with a complete new transformer and arc lighting system.

The T. Eaton Co., Ltd., Toronto, has given the Canadian General Electric Co., Ltd., a contract to supply another 130 k.w. 110 volt direct connected generator, as an addition to its already extensive plant. This company will now have probably the largest and most modern isolated plant in Canada.

The Montreal Cotton Co., Valleyfield Que., is constantly increasing its large electric transmission plant, of which the three-phase induction motor is found so satisfactory for cotton mill operation. There have recently been ordered from the Canadian General Electric Co., Ltd., three motors of 75, 50 and 10 h.p., respectively.

Local capitalists propose to subscribe the funds for the talked of Guelph-Hespeler electric railway.

An electric light plant has been added to the Standard Chemical Co.'s equipment, Deseronto, Ont.

The proposed Galt, Preston and Hespeler Railway would enter Galt via Doon and Blair and connect with the C.P.R.

The Montreal Cotton Co., of Valleyfield, Que., has ordered another 100 h.p. induction motor from the Canadian General Electric Co.

The Dominion Coal Co. proposes doing away with the horses used in the mine for hauling purposes, and will use electricity entirely.

The London Electric Light Company, Ltd., has secured an amendment to its charter increasing its total capital stock from $250,000 to $500,000.

The Canadian General Electric Co. has received an order from Stunden & Perrine, of Rossland, B.C., for a standard induction three-phase motor.

The Montreal Island Belt Line Co. is applying for increased powers in building branch lines, and to buy the Chateauguay and Northern Railway Co.

Jno. Forman, Montreal, has sold his property, 565 acres, at Shawinigan Falls, to the Shawinigan Water & Power Co., and the development will now proceed.

The Brantford Street Railway Co., Brantford, Ont., is installing six Canadian General Electric "800" railway motors, purchased from the Canadian General Electric Co.

The Canadian Pacific Railway Co. has placed an order with the Canadian General Electric Co. for one 75 k.w. three-phase synchronous motor for the Trail smelter, Trail, B.C.

The Winnipeg Electric Street Railway Co. has placed an order with the Canadian General Electric Co. for two additional Canadian General Electric "1,000" 2-motor equipments.

The National Electric Co., 1586½ Notre Dame street, Montreal, is the style of a new firm commencing business as electrical contractors, and making a specialty of installation for electric lighting.

The linemen of the construction department of the Hamilton Electric Light and Power Company recently struck for an increase from $8.50 to $10.50 per week for experienced hands. The demands of the men were granted.

A verdict for $4,000 damages was given against the Toronto Railway Co. recently for damages sustained by a Mrs. Darling, who fell and broke her leg, owing to the street car beginning to move while she was getting off.

The Canadian General Electric Co. is supplying the Hospital St. Jean de Dieu of Longue Point, Que., with a motor equipment of the standard Canadian General Electric 1,200-motors, including controllers, rheostats, etc.

The Electrical Maintenance and Construction Co. of Toronto, Ltd., has been formed by P. H. Patriarche, P .D. Ball, H. L. Dunn, W. M. Boultbee and others, of Toronto; capital, $20,000; chief place of business, Toronto.

The Dominion Oilcloth Co., of Montreal, has placed an order with the Royal Electric Co. for the complete equipment of its factory with "S.K.C." motors. The different units as required throughout the building in the different departments, aggregate over 150 h.p.

Hamilton, Ont., is understood to be the home of a large electrical combine similar to that alleged to exist in Montreal. The plan includes all the electrical plants in Hamilton, light, power and trolley, and is said to have designs on the Cataract Power Co., and the electric lines at Niagara Falls.

The Esquimalt & Nanaimo Railway Co., which is opening up its coal mines at Oyster Harbor, B.C., has decided to operate the entire mining and hauling apparatus by electricity, and for this purpose has placed their order for two direct connected units of 150 h.p. each, with Ideal engines, and two 40 h.p. mining locomotives with switchboards, and all the necessary supplies for the complete installation, with the Royal Electric Co. of Montreal. This is the second order that the Royal Electric Co. has received for mining locomotives and apparatus on Vancouver Island.

Joliette, Que., is extending its arc system, and has placed an order with the Royal Electric Company for a 50-light 2,000 c.p., T.H. Royal arc machine, with a full equipment of lamps. This is an addition to a recent purchase of an 120 k.w. "S.K.C." generator with transformer, etc., which was put in operation recently.

The Consumers' Cordage Co., of Montreal, is fitting out its factories with electric power and has placed its order with the Royal Electric Co. for two 50 h.p. "S.K.C." synchronous motors. The current for these motors is to be furnished by the Chambly Mnfg. Co. as soon as it has their current in the city, which is expected about the first of May.

The Montreal Street Railway Company is building a hundred new open cars for its summer service. One improvement is a safety board of wooden sheeting on the side of the car nearest the other tracks, instead of the wire screen, as formerly; the cotton cover intended to keep out rain is replaced by waterproof blinds, which fit tightly into frames.

A company to be known as the Nova Scotia Electric Light Co. is being organized to furnish electric light, heat and power to all points in the valley from Windsor to Annapolis, with branches to Canning, Kingsport, Granville Ferry and other outlying centres. The source of power will be the Gaspereau river, where there will be an effective head of water of 375 feet with a minimum flow of 8,000 cubic feet. F. B. Wade, Q.C., and C. E. Foss, are the organizers of the company.

The bill respecting the Hamilton, Chedoke and Ancaster Street Railway Company was passed by the Railway Committee of the Ontario Legislature with one amendment, which provides that the road may be run by electricity or compressed air but not by steam. The capital stock is raised from $100,000 to $300,000, and the line will in future be known as the Hamilton, Ancaster and Brantford Railway. An agreement may be made with the Brantford Street Railway for the use of its tracks.

The Riordon Paper Mills Co., Hawksbury, Ont., is lighting its plant throughout by electricity. An order has been placed with the Royal Electric Company, Montreal, for a 25 k.w. "S.K.C." two-phase generator, wound to deliver 110 volts. There will be 200 incandescent lamps installed from this throughout the mills, as well as ten alternating enclosed arc lamps. This is the fifth large mill or factory which has within the past year installed alternating current apparatus of the "S.K.C." two-phase type.

John Ross Robertson, of The Telegram, in laying out his new buildings at the corner of Bay and Melinda streets, Toronto, is arranging for a most complete electrical installation. All the printing machinery, shafting, hoists and elevators are to be operated by electricity as well as the lighting of the building throughout. The Goldie, McCulloch Co., of Galt, Ont., are furnishing the steam engines and boilers; the Sprague Electric Co. are furnishing the hoists and elevators, and the Canadian General Electric Co. is supplying the generators and slow-speed motors for lighting and power. A more detailed account of this ideal installation will be given in a later issue.

The regular annual convention of the Maritime Electrical Association will be held in Halifax, April 18th. The convention headquarters will be at the New Victoria Hotel, and the meetings will be held in the assembly room. The programme will be as follows: 9.30 a.m., meeting of the Executive Committee; morning session, 10 a.m., president's address, report of secretary-treasurer, report of committees, election of officers, general business. Afternoon session, 2 p.m., papers will be read by members on Iron Armoured Conduit Wiring, Fire Alarm Systems, Steam Engineering, Telephone Work and Electric Meters. Questions which have been suggested by the members will also be discussed. In the evening a reception, consisting of banquet and smoking concert, will be tendered by the Halifax members of the association. The president, F. A. Bowman, states that no effort is being spared to make this convention a success from every point of view; and all members attending will not only receive some very practical information from the papers to be read and the discussions which will follow, but will also find the occasion a most enjoyable one socially.

At the annual meeting of the Canadian General Electric Company all the old directors who are eligible were re-elected. The following comprise the board for the present year: W. R. Brock, president; H. P. Dwight, first vice-president; Frederic Nicholls, second vice-president and managing director; Hon. Geo. A. Cox, W. D. Matthews, Robert Jaffray, E. B. Osler, J. K. Kerr, S. D. Greene, E. W. Rice, jun., and H. Parsons.

The Folger-Hammond Mines Co. has given a contract to the Canadian General Electric Co., Ltd., which covers the installation of a complete transmission plant to operate their stamp mills and compressors from a water fall some three miles distant from the line. The generating plant will consist of a three-phase generator of 150 k.w. capacity, operating at 2,000 volts. For operating the machinery there will be supplied one 100 h.p. three-phase induction motor and one 20 h.p.

F. Richardson, assistant electrician of the C.P.R., accompanied by M. Grimes, Ottawa, and a staff of assistants, left early last month for the Pacific coast under instructions from the Minister of Public Works, to construct a telegraph line from Skaguay to Dawson. The estimated cost of the line for the distance of 600 miles between the two points named is $150,000. It is expected that the line will be in operation by the 15th of November. Whether the sea link will subsequently be connected by a cable between Vancouver and Skaguay, or whether the Government line from Quesnelle, in the Cariboo country, will be extended northward to connect with the Skaguay-Dawson line, has not been made known.

The specifications on which the Central Construction Company was awarded the contract for the power plant at Orillia, Ont., provide for a solid masonry dam, laid in cement. There are two steel flumes, with an opening in the dam for a third. The power house, which is to be fire-proof, will be 62x36. The company also undertakes to cut down all trees along the route, to furnish two motors for the present plant, one for the pumps and one for lighting plant. The Westinghouse Company is supplying the electrical machinery; the Stillwell-Bierce and Smith-Vaille Company the wheels. The Central Construction Company gives a bond of $12,000 from the National Security Company, good for sixteen months (which will carry the town over the freshets of the spring of 1900), that the dam, etc., is of sufficient strength, and one of $5,000 for four years.

Judge McDougall, in a judgment delivered March 27th, upheld the conviction of the Toronto Railway Company for a breach of the city by-law which provides that every railway operating within the limits of the city shall, during the months of January, February, March, November and December, provide each car with a proper and sufficient vestibule to protect the motorman and others in charge of the car. His Honor held that the meaning and interpretation of the by-law is plain, and the conviction should be affirmed, and the appeal dismissed with costs. He found that the evidence showed that the conductor and motorman were in charge of the car within the ordinary meaning of the expression. His Honor added: "As to the argument that the rear-end vestibule would interfere with the proper working of the car, it should be addressed to the city council." His Honor also found that the objection raised as to the alleged application of the Dominion Railway Act, owing to the fact that the Street Railway Company's tracks crossed the tracks of the G.T.R. and C.P.R., was not sustained.

Personal.

William Clare has been appointed to the charge of the East End sewage disposal works, Hamilton, Ont.

Horace Mabee, a graduate of the Kingston School of Mines, has been appointed chemist of the Deseronto Iron Co.

Samuel Hall, one of the oldest employees of the G.T.R., Belleville, died last month. He was 25 years an engineer, and for twenty years had charge of the pump house in Belleville.

Thos Potter, in charge of the electric lighting plant, Walkerton, Ont., received a shock at 1,000 volts last month, and was severely injured though not killed. He was sitting reading a newspaper, and leaned back in his chair till his head came in contact with a wire.

Geo. A. Calvert, who represents the Fairbanks Co., Montreal, Fairbanks' standard scales, asbestos disc valves, etc., called upon us recently while in Toronto.

C. J. Peppin, night watchman in the Parliament Buildings, Toronto, has been appointed engineer at the Deaf and Dumb Institute, Belleville, Ont. The position carries with it a salary of $600 and house rent free.

Near Millwood station on the Manitoba and Northwestern railway the engineer, W. Hill, and the fireman, P. Donlon, were instantly killed, March 6th, by the explosion of the locomotive boiler, while working up a steep grade.

Joseph Chartier, thirty years of age, a wire drawer in the Dominion Wire Works, Lachine, Que., while at work became entangled in a mass of wire, which drew him into a cutting machine, with the result that his left foot was almost completely severed.

The death took place in St. Thomas recently of William Chambers, ex-locomotive foreman of the Grand Trunk shops. Mr. Chambers was born in England in 1828, and on coming to Canada entered the employ of the G.T.R. in 1854, and only left its employ in 1888.

Joseph R. Roy, C.E., resident engineer-in-chief for the Dominion Government in British Columbia, who has been for some weeks in Montreal recuperating from a severe illness, has gone in charge of a party sent by the Dominion Government to Dawson City, in the Yukon, to make some surveys and carry out needed public works.

The scaffold erected inside of a large sawdust burner for the purpose of repairs at the mills of W. C. Edwards & Company, Rockland, Ont., gave way just as the men were entering at 1 o'clock, March 20th, and coming down upon the five who entered, killed four of them. The dead are: Louis Rochon, Henry Dalrymple, Eugene Deschamp, Archie Stewart. Xavier Frappier was four hours under the debris and was finally got out seriously hurt.

At a meeting of the Can. Assoc. Sta'ry Engineers, Montreal No. 1, held shortly after the death of Capt. Jas Wright, an honorary member of the association, many expressions of regret were made by the members at the loss of an earnest and faithful friend. A motion of condolence and sympathy was unanimously passed, and the meeting adjourned immediately out of respect to his memory. Capt. Wright was one of the oldest and most reliable mechanical engineers in the country, was for many years superintending engineer of the dredging plant of the Montreal Harbor Commissioners.

It is announced that the Joule scholarship for physical research has been awarded by the council of the Royal Society, London, to Howard T. Barnes, M.Sc., demonstrator in the Physics department, McGill University, Montreal, and whose training has been received at McGill. The annual value of the scholarship is a hundred pounds, and it is generally awarded for two years. Mr. Barnes will continue the researches into the specific heat of water on which he has been for some time engaged.

The death took place recently at Albany, N.Y., of Arthur S. C. Wurtele, C.E. The deceased, who was 69 years of age, was the second son of the late Jonathan Wurtele, seigneur of River David, and was born at Quebec. He studied civil engineering with Walter Shanly, C.E., and afterwards received an appointment as one of the resident engineers of the New York Central Railway. He was next appointed deputy state engineer of the State of New York. He retired a few years ago, having gained an excellent and widespread reputation as an engineer.

F. H. Badger, only son of Mr. Badger, Montreal, city electrician, died a short time ago at his father's residence, Montreal. Deceased, who was 36 years of age, was an expert electrician and for many years in the service of the Royal Electric Company, having charge of the outside work and installing the company's present wire system. Some four years ago he went to Quebec to take charge of the Montmorency and Quebec Electric Light system. On the amalgamation of that system with the Quebec Street Railway Company, last year, he went to New York, where he has since been engaged. He was offered his choice of two good positions, one in Washington, D.C., the other in St. Paul, Minn. Before deciding which to accept he determined to visit both places. After doing so he decided to accept the post in Washington, but was suddenly taken ill. When he was at Washington the weather was mild, and he wore light clothing. When he reached St. Paul the thermometer stood at 45 below zero, and he caught a severe cold, which had developed into pneumonia by the time he reached Montreal, and resulted, as stated, in his death.

F. G. Beckett, Hamilton, Ont., died very suddenly at Inglewood, N. J., last month. Grip was the cause of death. Deceased went to Inglewood in January to visit a married daughter. He was about 70 years of age, and was well known in Hamilton for almost half a century. Many years ago he had an engine works where the cotton factory now is and did a big business during the oil fever. He manufactured engines and boilers for the big freight ferry boats which ply between Windsor and Detroit. Later he was in partnership with J. W. Killey, and had works on Barton street. For some years he has been before the public as the promoter of the Beckett drive, along the mountain side.

There was a big sensation in civic circles in Ottawa last month. Early in March Assistant City Engineer Perreault was suspended for making errors in measurements. A little later City Engineer Galt was advised to reinstate him, but Mr. Galt, having previously been given full power to deal with his subordinates as he thought proper, called for Mr. Perreault's resignation. This angered Mayor Payment, whose friend Mr. Perreault is, and the mayor suspended Mr. Galt for "having usurped the authority of the council," and placed Mr. Perrealt in charge. The city council promptly resented this action on the part of the mayor and appointed a new assistant engineer.

J. T. Nicolson, head of the department of Mechanical Engineering at McGill University, Montreal, since 1891, has resigned on account of receiving an Appointment in Manchester, Eng., as head of the Mechanical and Electrical Departments of the Municipal Technical School there. For his experiments in compression, which threw added light on geology, and for his work with Prof. Callender in preparing the paper on the steam engine read before the Institute Civil Engineers, Great Britain, in 1897, Mr. Nicolson has received well-merited honors. For the paper Mr. Nicolson was awarded the Watts gold medal and a Telford premium of £20. by the Institute of Civil Engineers, London, and for the two researches he obtained the degree of D.Sc., from Edinburgh last summer.

Early on the morning of March 7th A. Galloway, foreman of a gang of men at the Imperial Oil Company's works, Sarnia, Ont., ordered some of his men to clean out one of the oil tanks in the company's yards. James McCue proceeded down into the tank. When he reached the bottom he was seen by his fellow workmen to fall down. Another workman named John Carter went down to rescue McCue, but no sooner reached the bottom of the tank than he too was overcome by the gas. The foreman, Galloway, was the next to attempt the rescue of the men, and he shared the same fate as the preceding two men. Henry Willis then came to the unfortunate men's rescue, but he, too, was overcome, as was also another employee, named William Brimbs. By this time the alarm had been given that some men were being smothered in a still, and a gang of men from the boiler-shops were soon on the scene and proceeded to tear the covering from the still to allow the gas to escape, and thereby make it safe for men to descend into the still. Before this work was completed William McCue attempted to go down the ladder, but when half-way down he fell, being almost overcome, but managed to climb part way up again, and was pulled out of the still just in time, as he fainted when he reached the ground. After the covering had been torn away, and the gas allowed to escape, other employees went into the still, and the five men who were lying in a heap at the bottom were hoisted to the top, and all that was possible was done for the unfortunate men. Doctors, who were hastily summoned, worked over the poor fellows from that time until late in the afternoon, when their efforts were finally successful. The courage of the men who went down to face what seemed probable death one after another cannot be too highly praised.

Marine News.

Matthew's Line, Toronto, Ont., has appointed to the steamers "Niagara," Capt. Jas. Morgan, Engineer Thos. Mills; "Clinton," Capt. John Fahey, Engineer J. M. Donaldson.

Alexander Horn, of Oldrieve & Horn, sailmakers, Kingston, Ont., has been notified of his appointment as Government inspector of hulls in succession to Thomas Donnelly, resigned.

Merchant's Line, G. E. Jacques & Co., Montreal, have appointed to the propellers "Cuba," Capt. Henry Chestnut, Engineer William Kennedy; "Melbourne," Capt. Fred. Elliott, Engineer Thos. Milne.

Lake Ontario & Bay of Quinte Steamboat Co., Kingston. Ont., has appointed to the steamers "Hero," Capt. Wm. Bloomfield, Engineer Robt. McEwan; "North King," Capt. John Jarrell, Engineer O. J. Hickey.

Canadian Pacific Steamship Co., Montreal, has appointed to the steamers "Manitoba," Capt. E. B. Anderson, Engineer W. Lewis; "Athabasca," Capt. G. McDougall, Engineer W. Lockerbie; "Alberta," Capt. J. McAllister, Engineer Angus Cameron.

St. Lawrence & Chicago Steam Navigation Co., Ltd., J. H. G. Hagerty, mgr., Toronto, Ont., has appointed to the steamers "Algonquin," Capt. James McMaugh, Engineer James H. Ellis; "Rosedale," Capt. James Ewart, Engineer Ed. O'Dell.

Hepburn, A. W., Picton, Ont., has appointed to the steamers "Alexandria," Capt. E. B. Smith, Engineer Chas. McWilliams; "Aberdeen," Capt. M. Heffernan, Engineer Frank Theriauld; "Water Lily," Capt. M. Hicks, Engineer George Gerow. Schooners "Rob Roy," Capt. Homer Peron.

McKay R. O. & A. B., Hamilton, Ont., has appointed to the steamers "Sir S. L. Tilley," Capt. W. O. Zealand, Engineer Joseph Boulanger; "Lake Michigan," Capt. Arthur Lefebvre, Engineer Joseph Dawson; "Myles," Capt. John S. Moore, Engineer Jas. Smeaton. Schooner "T. R. Merritt," Capt. William A. Corson.

North Shore Navigation Co., Collingwood, Ont., has appointed to the steamers "City of Collingwood," Capt. W. J. Bassett, Engineer Chas. Robertson; "City of Midland," Capt. F. X. La France, Engineer Wm. Whipps; "City of Toronto," Capt. John O'Donnell, Engineer D. McQuade; "City of Parry Sound," Capt. Ernest Walton, Engineer J. L. Smith; "City of London," Capt. W. W. Storey, Engineer Jas. Crossland.

The Richelieu & Ontario Navigation Co. has made the following appointments to the various steamers of the fleet for the season:

Steamer.	Captain.	Engineer.
"Quebec"	L. O. Boucher	F. Gendron
"Montreal"	L. St. Louis	F. X. Hamelin
"Canada"	J. Dugal	E. Denis
"Saguenay"	C. Lapierre	
"Carolina"	G. Riverin	M. Latulippe
"Three Rivers"	F. St. Louis	J. Matte
"Berthier"	C. Gouin	E. Arcaud
"Terrebonne"	F. E. Gouin	G. Gendron
"Chambly"	Geo. Paulch	C. Gendron
"Laprairie"	P. McLean	N. Beaudin
"Cultivateur"	O. Raymond	H. Noel
"Longueuil"	F. Jodoin	N. Beaudet
"Hochelaga"	H. Maudeville	F. Chapdelaine
"Hosanna"	D. Mongeau	E. Gendron
"Meuche-a Feu"	— Crepeau	P. Boucher
"Sorel"	— Berthiaume	— Beaucage
"River-du-Loup"	— Faubert	L. Godin
"Toronto"	H. Esford	Wm. Black
"Spartan"	H. P. Grange	
"Algerian"	D. Mills	
"Bohemian"	A. Dunlop	A. R. Milne
"Hamilton"	A. J. Baker	L. Marshall
"Corsican"	John McGraw	Wm. Parker

Calvin & Co., Garden Island, Ont., have appointed to the steamers "D. D. Calvin," Capt. A. H. Malone, Engineer T. C. Smith; "Bothnia," Capt. G. A. Brian, Engineer R. Veech; "Armenia," Capt. Chas. Coons, Engineer W. Cunningham; "Reginald," Capt. John Doyle, Engineer J. Kennedy; "Chieftain," Capt. John Sullivan, Engineer T. Gray; Parthia, Capt. David Lefavre, Engineer G. Sauve; "W. Johnston," Capt. Ed. Phelix, Engineer T. Harper; "Bluchell," Capt. John Dix, Engineer C. LeRiche.

At the meeting of representatives of the Canadian Marine Engineers' Associations of Toronto, Vancouver, B.C., and St. John, N.B., last month, in the Confederation Life Building, Toronto, it was unanimously decided to amalgamate the three distinct societies. About 60 delegates were present, and the chair was occupied by Harry Parker, president of the Toronto organization. At a meeting held in the morning of the visiting delegates, a report was drawn up and plans agreed upon for presentation before all the members. After three hours' discussion the entire meeting agreed on an amalgamation. Harry Parker, S. G. Mills and Robert Craig were appointed an Executive Committee, to meet in Montreal next autumn, and arrange a new constitution for the organization. The name will hereafter be the National Association of Canadian Marine Engineers, and it at present boasts of a membership of 350. Branches will also be instituted in Kingston and Montreal. The meeting then adjourned.

Brief, but Interesting.

The purchase of the Havana street railway by the Harvey syndicate of New York has been declared void by the Cuban courts, and the Canadian capitalists may now have an opportunity of exploiting the transportation facilities of the island.

Alternating current apparatus for all purposes is making progress in Canada, and it is said that before many months there will be alternating current street railway apparatus in use in Canada. It is already extensively used in Europe, especially in Switzerland, and the larger companies in the United States are experimenting with it, and have already built a new road entirely equipped with alternating current apparatus, which is giving satisfaction.

The most complete telephone system in the world has just been inaugurated in Stockholm, Sweden. It is not in the hands of a syndicate or a trust, but under the immediate control of the Government. There is hardly a residence in Stockholm and the neighboring towns not connected with central offices. The telephone tax is levied in the same manner as the water tax and amounts to only $5 a year. In this connection it is interesting to notice the large appropriations made at the present session of the British Parliament for the establishment of a Government telephone system in connection with the postoffice and in opposition to the private companies, whose inadequate service has been the cause of so much complaint on the part of the public

H. W. Wood, instructor in physics in the University of Wisconsin, has originated the idea of thawing out water pipes with electricity, and has made successful experiments. He takes the electric current used for street lighting purposes, attaches one wire to the frozen pipe inside the cellar of one house and the other wire to a similar pipe in the adjoining or any other house, thus completing the circuit. A current of about fifty volts is then turned on, heating the pipes and melting the ice within. At Chatham, Ont., experiments in this method were made under the direction of Superintendent Jones of the Waterworks Department, and Manager Coate of the Gas Company. Two hydrants, 280 feet apart, were connected to the electric lighting circuit, and were thawed out in 45 minutes. Another hydrant, distant 129 feet from the first, was also connected, and thawed out in 24 minutes.

Ball bearings have been little used on heavy vehicles because it is difficult to make them endure the great pressure. A form of ball bearing devised by Schuppiser has been tried on street cars of Zurich, at first unsuccessfully, as in other ex-

periments, but more satisfactorily since balls to take up side pressure have been employed in addition to those carrying the weight. In their present form, the bearings have two rows of sixteen ¾-inch balls, and two rows of twenty-six ½-inch balls each. To distribute wear, the bearings are arranged so that they can be moved into four different positions. Some of the bearings have now been under test more than two years, Podoski reports, but much trouble was at first experienced with the bearings for the balls. For a few months these have been made of Krupp's crucible steel, which is thought to have quite overcome the difficulty. It is found that an average saving of 15 per cent. of the total power has resulted on the four electric railways experimented on, and as high as 24 per cent. on one line, with 35 per cent. under the most favorable conditions. In every case a saving has been shown, even on steep grades.

Mining Matters.

It is reported in Quebec that gold yielding $20 a ton has been discovered near Lorette, Que.

Bonham & Munroe have commenced business as mining brokers with offices in Canada Life Building, Montreal.

A very rich strike of placer gold is reported from Tete Jeune Cache at the headwaters of the Fraser river, B.C.

The Newcastle Coal Co. at Port Morien, C.B., has given a contract for a considerable amount of mining machinery again.

The Crow's Nest Pass Coal Co. turned out 2,000 tons of coke from the oven at Fernie, B.C., in the month of February.

The Crow's Nest Coal Co. has secured the contract to supply the British fleet at Esquimault with coal for the present year.

A letter from A. P. Low, of the Geological Survey staff, which is wintering on Hudson's Bay, confirms previous reports of the existence of deposits of magnetic iron ore on the shores of the bay.

At the annual meeting of the Mining Society of McGill University Dr. Harrington was elected honorary president, Mr. McMillan was elected president, Mr. Cowans, vice-president, and Mr. Archer, secretary-treasurer.

It is stated that work will soon be started upon the erection of a 400-ton smelter at Greenwood, B.C. The capitalization of the company is $400,000, and J. P. Graves, prime mover of the Old Ironsides and Knob Hill, is the promoter.

The following gentlemen are interested in active mica mining near Kingston, Ont.: Kent Bros., bankers; E. H. Smyth, Q.C., I. Franklin, merchant; Mr. Chown, of the Webster Co., Sydenham, and J. L. Gemmill, Perth, Ont.

The zinc mine situated between Rossport and Schreiber on the C.P.R., about twelve miles from the mouth of the Gravel river, which was sold to a Belgian syndicate last year by Jno. McKellar, Fort William, Ont., is shipping freely to Belgium, where it is stated the ore nets almost $40 per ton.

W. C. Caldwell and T. B. Caldwell, accompanied by Arch. Blue, director of the Ontario Bureau of Mines, made a visit to the gold mines at Ardoch, Addington county, Ont., owned by the Boerth Mining Co., Detroit. A boarding house has been erected and some sixty men are at work. Five large furnaces and a pulverizer are used in reducing the ore, which has proved to be rich, assaying from $24 to $160, and $50 to $500 per ton. The mine is situated not far from the Kingston & Pembroke Railway, and is on the Mississippi river.

The lead and zinc deposits in Tudor township, Hastings county, Ont., are beginning to attract attention. The Hollandia and Catharine mines are said to have assayed very heavy values in lead and zinc. This is the first discovery of zinc in Hastings county, although its presence in the mineral belt was referred to about twenty years ago in a paper read by T. Campbell Wallbridge before the Royal Geological Society of London. One of the deposits is only ten miles from Millbridge on the Ontario Junction Railway.

The summer mining class of McGill University which proved so successful last year, will be continued this year. The party will leave McGill, under Dr. Porter, about the 25th of April and will spend about four weeks in the work. This year they go to the United States and will visit the anthracite mines of Central Pennsylvania. Here they will be able to see some of the largest coal mines in America, and will be able to observe the railway transportation there carried on, as well as the actual mining operations. Exactly what mines will be visited is not yet definitely settled, but invitations have been sent to Dr. Porter from several mines.

Railway Matters.

One thousand freight cars are to be built by the C. A. and O. A. & P. S. Railways this year.

The Central Vermont Railway was bought at auction by a representative of the G.T.Ry., March 21st, for $7,000,000.

G. L. Mattice, Montreal, is engineer-in-charge of construction of the Rutland & Canadian Railway from Aldburgh to Novar Junction.

It is said that the C.P.R. will build a coal wharf and sheds at St. John, N.B., so that it may be in a position to send 200,000 tons of coal per annum to Montreal.

—The judicial enquiry into the composition of the reports on the efficiency tests of the Green's Economizer at the Toronto waterworks main pumping station is proceeding before Judge Macdougall. The city engineer has ended the state of hostilities among the staff at the high level pumping station by discharging the whole staff and appointing Wm. Hall from the main pumping station in charge, and Woodward, of the Niagara Nav. Co., and McKeown, G.T.R., to fill the vacancies.

—The provisions of the Ontario Act dealing with the Niagara Power question rushed through by the Government at the end of the session are mainly two. The first provides that the Commissioners of Queen Victoria Niagara Falls Park may, with the approval of the Lieutenant-Governor-in-Council, enter into an agreement with the Canadian Niagara Power Company for the surrender by the latter of its sole right to use the waters of Niagara river within the limits of the park, upon such terms and conditions as to abatement of rent, extension of time for carrying out the agreement of 1892, variation of that contract, etc., and that any arrangement so entered into shall be binding. The second resolution provides, in brief, that the Park Commissioners may enter into contracts with other persons or companies to enable such persons or companies to use the waters of the Niagara within or without the park for power purposes, but it does not add, as in the case of the former resolution, that any such contract is to be binding.

FIRES OF THE MONTH.

March 3rd. J. Stuart's machine shop, Thorold, Ont.; damages, $18,000; insurance, $10,000.——March 12th. Hamilton Radial Railway Co.'s workshop, Hamilton Beach; damages, $5,000; fully insured.——March 22nd. Elliot & Brooks' paper box factory, Adelaide street west, Toronto; damages, $25,000; insurance, $16,000.——March 28th. G. G. Bryant's sash and door factory, Sherbrooke, Que.; insurance amounting to $6,300 will not cover loss.

THE NICHOLSON PATENT FLANGED FACE COMPRESSION SHAFT COUPLING.

The makers of this coupling claim for it that in design, construction and general operation, it more completely meets the requirements of a first-class shaft coupling than any other on the market. In appearance it resembles the ordinary flanged face coupling. The two half castings are bored tapering, and have flanges on rim to cover bolt heads and nuts. The outer faces of hubs are closed almost to shaft by a rib or projection, through which slots are cut to space the jaws a uniform distance apart and hold them in position while coupling is being fixed on the shaft. The steel jaws have double taper, turned to fit bores of castings, and are concaved on their inner

faces a trifle less than the radius of shaft, which makes the grip positive when flanges are drawn up by the bolts. The couplings are fitted so that flanges stand from ⅜ to ¾ of an inch apart when drawn tight with the bolts, thus enabling a trifle larger or smaller size of shaft than gauge to be coupled. Owing to this feature extra couplings may be carried in stock, so that in case of an accident they can be immediately applied to the shafts that have been broken and twisted off, or another shaft may, it is stated, be coupled on without the necessity of key seating the old shaft or making exact measurements to ensure a perfectly tight fit. The Nicholson patent flanged shaft coupling is placed on the market by the Fairbanks Co., Montreal, and is, we are told, being installed by the company in place of less up-to-date appliances.

CANADIAN PATENTS.

The following patents of interest to engineers were issued in January:

No. 62,176.—Electric arc lamp; The British Blahnick Arc Light Co., Westminster, London, England.

No. 62,177.—Rail joint for electric railways; The firm of Ausfuhrungenfur Eisenbahn, Oberban, Abtheilung "Stossfangschienne," Seigm, Eppenstein, of 45 Wilhelmstrasse, Berlin, Germany.

No. 62,181.—Acetylene gas generator; Isidore Therien, Quebec, Que.

No. 62,186.—Acetylene gas generator; Francis Xavier Nadon, Maniwake, Que.

No. 62,194.—Acetylene gas generator; E. J. Dolan, Philadelphia, Pa.

Nos. 62,199, 62,200, 62,201.—Motor; Zdzislav Maevsky, St. Petersburg, Russia.

No. 62,203.—Acetylene gas generator; J. W. Scarth, Pudsley, York, England.

No. 62,207.—Turbine; Jos. Chew, Orillia, Ont.

No. 62,214.—Telephone transmitter; F. A. Ray, Boston.

No. 62,217.—Railway rail joint; T. C. H. Gray, Gray Bridge, Mass.

No. 62,219.—Trolley connection for canal boats; F. J. Shewring, Toronto.

No. 62,224.—Solenoid blow-out for displacing, dispersing, or extinguishing, formed in breaking electric circuits; S. H. Short, Cleveland, O.

No. 62,243.—Drill clutch; W. L. Hirlinger, Luzerne, Penn

No. 62,249.—Device for moving dredging machines; J. W. Pike, Vancouver, B.C.

No. 62,262.—Insulator; E. Renault, Florida, U.S.A.

No. 62,264.—Electric arc lamp; Thos Spencer, Philadelphia, Pennsylvania.

No. 62,269.—Smokeless furnace; Ed. Gessner. No. 60 Krona, Brunn, Austria.

No. 62,278.—Railway tie and clamp; Chas. A. Cole, New York.

No. 62,281.—Acetylene gas making machine; A. Holland, Ottawa, Ont.

No. 62,282.—Acetylene gas lamp; John Zimmerman, Chicago, Ill.

No. 62,283.—Acetylene gas machine; P. H. Mace, Paris, France.

No. 62,293.—Track clearer; James C. Cameron, Montreal.

No. 62,294.—Acetylene gas generator apparatus; Jean A. Piantin, Ottawa, Ont.

No. 62,312.—Motor vehicle; The Prelot Motor Syndicate, Butolph House, Eastcheap, London, England.

No. 62,336.—Electric engine; Marcy Lelland Whitfield, Chicago, Ill.

No. 62,339.—Steel manufacture; Thos. J. Heskett, 50 North Terrace, Adelaide, South Australia.

No. 62,341.—Steam boiler furnace; Geo. N. Robinson, Brooklyn, N.Y.

No. 62,356.—Flat-railed railway; H. L. Stillman, Charlestown, Rhode Island.

No. 62,359.—Car coupler; Philip Hien, Chicago, Ill.

No. 62,361.—Brake shoe; A. J. Allen, Chicago, Ill.

No. 62,377.—Telephone; R. W. Wallace, 21 De Vere Gardens, Kensington, London, England.

No. 62,378.—Furnace grate; Henry Truesdell, Toronto.

No. 62,385.—Heater and radiator; Chas. Ellingsen, Ashby, Minn., U.S.A.

No. 62,389.—Instrument for determining the amount of elongation and compression of railway rails under moving trains; P. H. Dudley, New York, N.Y.

No. 62,390.—Electric track circuit rail joint; Wm. H. Talley, Waco, Texas.

No. 62,392.—Heater; John A. Markle, Birtle, Man.

No. 62,410.—Compound steam engine; Jos. Hardell, Stratford, Ont.

No. 62,416.—Car pushing device; Wm. L. Joy, Toronto.

No. 62,424.—Boiler; Calixte Cauchene, St. Gabriel de Brandon, Que.

No. 62,440.—Telephone number and address: Annunciator; Wm. J. Walsh, Hamilton, Ont.

No. 62,447.—Steam boiler and furnace; Wm. Hopkins, Dubuque, Iowa.

No. 62,449.—Electric railway truck; Geo. J. Capewell, Hartford, Conn.

No. 62,450.—Gas generating process; Samuel H. Wood, Wilmette, Ill.

No. 62,451.—Steam boiler; David Fitzgibbons, Oswego, N.Y.

No. 62,453.—Steam boiler; N. F. Anderson, Hardid, Ill.

No. 62,455.—Steam boiler; R. Hutchinson, Somerville, Mass.

No. 62,456.—Steam boiler; Geo. H. Watson, Chicago, Ill.

No. 62,457.—Boiler; R. W. Innes, Omaha, Neb.,

No. 62,458.—Steam generator; Henry Hening, Paterson, New Jersey.

No. 62,463.—Acetylene gas lamp; Geo. D. Pearson, Montreal, Quebec.

No. 62,464.—Acetylene generator; F. Cortez Wilson, Chicago, Ill.

No. 62,466.—Process of, and apparatus for, the manufacture of metallic carbides.

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Village of Hintonburgh.

TENDERS FOR WATERWORKS

Tenders for constructing a system of waterworks for the Village of Hintonburgh, sealed, and endorsed "Tenders for Waterworks," will be received until noon of Saturday, 15th April, 1899, addressed to W. A. Mason, Esq., Village Clerk, Hintonburgh, Ontario.

Each tender must be accompanied with an accepted bank cheque for an amount equal to five per cent of the amount tendered and made payable to the order of W. A. Mason, Treasurer of the Corporation, which cheque will be forfeited if the contractor declines to enter into a contract when called upon to do so.

The Corporation reserves the right to reject any or all tenders.

Plans and specifications can be seen, and printed specifications and forms of tender obtained at the office of the Clerk, Town Hall, Hintonburgh.

Dated at Hintonburgh this 23rd day of March, 1899.

(Signed) D. H. McLEAN, Reeve.

(Signed) CHARLES H. KEEFER, Consulting Engineer, Ottawa.

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